

PROJECT MANUAL FOR  
OCEAN AVENUE ELEMENTARY SCHOOL  
PORTLAND, MAINE

A/E. COMM. NO. 3316.10

BGS PROJECT NO. 723

MARCH 18, 2009

**PERMIT APPLICATION SUBMISSION**

OWNER: PORTLAND PUBLIC SCHOOLS  
196 Allen Avenue  
Portland, Maine 04103

ARCHITECT/ENGINEER: WBRC ARCHITECTS·ENGINEERS  
141 Preble Street  
Portland, Maine 04101

CONTRACTOR:



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announcing the names of the Sub-Contractors filing subcontract Proposals. This lump sum allowance shall be included in the proposal of all General Contractors.

(e) In the event a filed subcontract proposal is requested but none received, the Bureau shall establish a lump sum allowance for that trade and include it in the letter to the General Contractors announcing the names of the Sub-Contractors filing subcontract proposals. This allowance shall be included in the proposal of all General Contractors in lieu of a filed subcontract proposal.

(f) After opening the filed subcontract proposals, if all are found to be invalid for any particular trade or trades, the amounts used by General Contractors for any particular trade or trades in preparing their proposals shall be deducted from the total of the proposal of each General Contractor and the contract shall be awarded to the lowest responsible General Contractor after said deductions are made.

(g) Telegraphic subcontract proposals will not be considered, but modifications by telegram of subcontract proposal already filed will be considered if received prior to the hour set for receipt of subcontract proposals. If the telegram discloses the amount of the subcontract proposal submitted the subcontract proposal would be declared invalid.

3. (a) Any SUBPROPOSAL received from a General Contractor who does not have the qualified personnel or experience for that particular trade shall be considered informal and not a valid SUBPROPOSAL.

(b) At the expiration of the time stated for the filing of sub-proposals, the Maine Construction Bid Depository will mail to the General Contractors, who have taken plans and specifications, the names of Sub-Contractors who have filed their sub-proposals with the bid depository in accordance with the provisions of these instructions to bidders. If any General Contractor has not received a copy of this list of sub-bidders, within a reasonable time following the time set for their delivery, he should contact the Maine Construction Bid Depository for confirmation of the list of sub-bidders who have filed, prior to the completion of his own proposal.

(c) General Contractors will be furnished by the Designer two (2) copies of the proposal form for General Contractor. One (1) copy shall be filled out and signed and sent to the Owner in *a printed envelope furnished by the Designer* to arrive on or before the time specified in the "Notice to Building Contractors" Section 2-A.

(d) Each proposal by a general contractor shall be submitted on a form provided, and the list of specified subcontractors with their respective subproposals shall be complete. Any proposal submitted by a general contractor with an incomplete list of filed subcontractors shall not be considered a valid proposal. Any proposal by a general contractor with the name or names of filed subcontractor(s), who have filed not in accordance with these instructions to bidders, shall follow Article 2(c) of these conditions.

(e) Any proposal, submitted by a General Contractor, with a sub-proposal amount for a Sub-Contractor's work different from the sub-proposal amount filed by that Sub-Contractor, shall have the sub-proposal amount filed substituted for the sub-proposal amount carried by the

General Contractor, after which the proposal of the General Contractor shall be adjusted by the difference, prior to the selection of the low General Contractor.

(f) Telegraphic proposal from the General Contractors will not be considered, but modifications by telegram of proposals already submitted will be considered, if received prior to the hour set for receipt of proposals. If the telegram discloses the amount of the proposal submitted, the proposal will be declared invalid.

4. The Owner reserves the right to reject any Sub-Contractor not qualified or whose proposal is invalid under these instructions to bidders, and will, before the selection of General Contractor, substitute another Sub-Contractor who is qualified and has properly filed.

5. Subject to the Owner's right, reserved herein, to accept or reject any or all proposals, the General Contractor will be selected on the basis of the sum of the lowest acceptable proposal plus such of the alternates as the Owner desires to use, it being understood that the Sub-Contractors listed in the said proposal shall be acceptable to the Owner.

6. After the selection of the General Contractor, the proposal of all Sub-Contractors will be considered by the Owner, Bureau of General Services, the Designer, and the General Contractor. Any agreement to substitute the names of Sub-Contractors other than those named in the General Contractor's proposal shall cause an adjustment of the contract amount in accordance with the Owner's copy of the subcontract proposals filed with the bid depository. If the said Sub-Contractor or Sub-Contractors so substituted fail to execute a subcontract, in accordance with their filed sub-proposal, with the selected General Contractor within five days of receipt of a subcontract from the General Contractor and before a contract between the Owner and the General Contractor shall select from the list of Sub-Contractors, who filed copies of their proposals, with the bid depository, a new Sub-Contractor or Sub-Contractors, and the contract amount shall be revised in accordance with the subcontract proposals so filed.

7. The Owner is exempt from the payment of Federal Excise Tax on articles not for resale and the Federal Transportation Tax on all shipments. The Contractor shall quote less these taxes.

8. Maine State Sales and Use Tax should not be included in your quotation as the Owner is exempt from the payment of such taxes. All Contractors and Sub-Contractors should refer to State of Maine, Bureau of Taxation - "Sales and Use Tax Division" for latest bulletin covering Sales and Use Tax Regulations.

9. No General or Subcontract proposal may be withdrawn during a period of thirty (30) calendar days immediately following the opening of the General contract proposals.

10. No contract may be assigned, sublet or transferred without the written consent of the Owner.

11. (a) All foreign corporations intending to do business in the State of Maine must comply with the provisions of Title 13-A M.R.S.A., Chapter 12. Any foreign corporation receiving

notice of award of contract shall contact the Secretary of State for the purpose of complying with this statute.

(b) All individuals not residents of the State of Maine are subject to the provisions of Title 14, M.R.S.A., Section 704-A.

(c) It may be necessary for the General Contractor to submit to the Owner documentary evidence that the provisions have been complied with.

12. (a) The selected General Contractor will be required to furnish a 100% performance bond and a 100% payment bond to cover the execution of his contract in conformity with the form of bonds shown in sections 2-C2 and 2-C3.

(b) The selected Contractors, required to file their sub-proposals with the bid depository, are also required to furnish the selected General Contractor with a 100% performance bond and a 100% payment bond for their portion of the work, in conformity with the form of bonds shown in sections 2-D2 and 2-D3.

13. General Contractors and Sub-Contractors may be required to furnish a statement of their business experience, record of accomplishments, and financial responsibility at the discretion of the Owner.

14. (a) The date of completion is stated in the proposal form section 2-B-1 and in the contract form section 2-E. If the Contractor finds it impossible to complete the work on or before the said date of completion, he may make a written request to the Owner for an extension of time setting forth therein the reasons for the request. If the Owner finds that the work was delayed because of conditions beyond the control and without the fault of the Contractor he may extend the date of completion in such amount as, in his judgment, the conditions warrant. The said new date of completion shall then be in full force and affect the same as though it were the original date of completion.

(b) Time is an essential element of the contract and it is important that the work be pressed vigorously to completion. The cost to the Owner of administration of the Contract, inspection and supervision will be increased as the time occupied in the work is lengthened.

15. (a) The proposal shall be based on the materials, methods, equipment and products as specified.

(b) Any materials, methods, equipment and products not herein specified but deemed worthy of consideration by any General Contractor or Sub-Contractor, may be introduced by a separate letter attached to his proposal. He shall state the cost comparison with the specified methods, equipment and products and the reason for the suggested substitution.

(c) It shall be understood by the General Contractor or Sub-Contractor that the attached letter describing the proposed change will not be used in determining the low General or Sub-Contract proposal submitted unless the General or Sub-Contractor shall have submitted their list

of proposed changes to the Designer 10 days prior to the date set for the receipt of their respective proposals, the Designer shall have issued an addendum related to the change(s) proposed, and the Contractor shall have received written approval by the Designer.

16. Employment Practices

(a) Listing of job vacancies; [Executive Order No. 5, dated December 6, 1971](#), requires that "the Contractor, or any Sub-Contractor holding a contract directly under the Contractor, shall, to the maximum feasible, list all its suitable employment openings with the Maine Employment Security Commission."

(b) "This provision shall not apply to employment openings which the Contractor proposed to fill from its own organization."

(c) Two copies of a "Quarterly Report of New Hires" shall be prepared by the 7th of January, April, July and October for the calendar quarter to which data pertains and sent to the local office of the Maine Employment Security Commission.

(d) A copy of the reporting form is attached to these Instructions to Bidders. These may be obtained from the nearest [office of M.E.S.C.](#) serving the area.

17. Code of Fair Practices; [Executive Order No. 11, dated July 1, 1972](#), requires that every State contract for public works contain the following provisions: "During the performance of this contract, the Contractor agrees as follows:

(a) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religious creed, sex, national origin, ancestry or age. Such action shall include, but not be limited to the following: employment upgrading, demotions, transfers, recruitment or recruitment advertising; layoffs or terminations; rates of pay or other forms of compensation; and selection of training including apprenticeship.

(b) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor; state that all qualified applicants will receive consideration for employment without regard to race, color, religious creed, sex, national origin, ancestry or age.

(c) The Contractor will send to each labor union or representative of the workers with which he has a collective or bargaining agreement, or other contract or understanding, whereby he is furnished with labor for the performance of his contract, a notice, to be provided by the contracting department or agency, advising the said labor union or workers' representative of the Contractor's commitment under this section and shall post copies of the notice in conspicuous places available to employees and to applicants for employment."

(d) The Contractor will cause the foregoing provisions to be inserted in all contracts for any work covered by this agreement so that such provisions will be binding upon each Sub-Contractor.

18. OSHA - Safety Regulations. This project is subject to compliance with all requirements of the Occupational Safety and Health Administration, Volume 36, No. 105 of the Federal Register, U.S. Department of Labor published Saturday, May 29, 1971 as amended.

19. Any proposal that contains an escalation clause will be invalid.
20. Any and all Designer interpretations and/or clarifications of bidding documents must be in the form of written addenda issued from the Designer office to all bidders who are on record at the Designer office not later than 72 hours prior to scheduled receipt of bids. (No verbal interpretations and/or clarifications shall be allowed as a substitute for written addenda.)
21. Questions by the bidder concerning alternate work descriptions/content/completeness and bidding process must be clarified with the Designer to assure the proper bidding and execution of all work intended under the alternate. This clarification must be in the form of a written addendum as described in item 20 above.
22. Preparation of filed sub-bid proposal.
  - (a) Filed sub-bidders are responsible for filing a complete proposal in the form of Maine Construction Bid Depository Form. ([BGS/72/B2.](#))
  - (b) Quotation must include cost of work specified in all addenda issued from the Designer office 72 hours prior to the scheduled time of receipt of proposal.
  - (c) Any sub-bid proposal which fails to indicate the cost of the work specified in any alternate (work relating to bidders trade area) may be declared informal if Owner elects to include the alternate in the General contract.
  - (d) Acknowledge all addenda legally issued. (Failure to acknowledge addenda may be cause to have sub-bid declared informal.)
  - (e) Sub-Contractor may include license number, as applicable.
  - (f) Include corporate/partnership information as required.
  - (g) Proposal must be signed in ink.
  - (h) Proposal must be supported by a properly signed and executed bid bond.
23. Preparation of General Contract Bid Proposal.
  - (a) General contract bidders are responsible for the completeness of their bid proposal on form issued with bidding document.
  - (b) Proposal must show cost of work specified including work specified; in any and all legally issued addenda.
  - (c) Any General contract proposal which fails to include the cost of work specified in an alternate may be declared informal if the Owner elects to include said alternate in the General contract.
  - (d) Proposal is to acknowledge all addenda that may have been legally issued. (Failure to acknowledge may be cause to have bid declared informal.)
  - (e) Indicate time for completion of the work, if required.
  - (f) Include corporate/partnership information as required.
  - (g) Proposal must be signed in ink.
  - (h) Proposal must be accompanied by required certified or cashier's check or a duly signed and executed bid bond.

LONG FORM  
SECTION 1-B  
MAINE CONSTRUCTION BID DEPOSITORY  
GENERAL CONDITIONS AND REGULATIONS

NAME AND LOCATION

The Depository shall be known as MAINE CONSTRUCTION BID DEPOSITORY and shall be located at the office of the Associated General Contractors of Maine, Inc., Whitten Road, P.O. Box 5519, Augusta, Maine 04432-0551. Tel. 622-4741.

DEFINITION AND PURPOSE

The Bid Depository is a system designed to maintain a high standard of bidding practices in the construction industry. It provides for the reception of sealed bids from subcontractors whereby the sanctity of bidding is protected and adequate time is provided for the general contractor to compile bids completely and accurately. These procedures are in the best interest of owners, architects, engineers, contractors and subcontractors.

Whenever the word "Designer" is used throughout this text, it shall be understood to mean "engineer of architect." Additionally, whenever the word "subcontractor" is used throughout this text, it shall be understood to mean "materials supplier" where applicable.

ELIGIBILITY

Any general contractor, subcontractor, designer or owner may use the facilities of the bid depository, regardless of membership in any association or geographic location, provided the conditions and regulations established by the depository are followed.

SCOPE

The bid depository shall accept and transmit bids for those trades named in the project manual.

MANAGEMENT

The depository will be operated and managed by the Associated General Contractors of Maine, Inc. in accordance with these general conditions and regulations.

DEPOSITORY FEE

The fee for each use of the depository shall be two hundred fifty dollars (\$250.00), payable by the designer to the Maine Construction Bid Depository.

ADVISORY COMMITTEE

A Bid Depository Advisory Committee shall be maintained to provide project owners and awarding authorities with advice and counsel relative to matters concerning the administration of the bid depository filed bid system.

The Committee shall consist of two (2) architects, two (2) engineers, two (2) subcontractors and two (2) general contractors, all to be selected by the AGC Building Specifications Committee, after consultation with MAIA, CEM, ASAM and ABC. Two (2) at-large members shall be selected by the committee once formed. The chairman shall be chosen by the committee members, but the chairmanship shall alternate bi- annually between a general contractor and a subcontractor.

Meetings of the advisory committee shall be called, as necessary, by the chairman or by a quorum of the committee membership. A quorum shall consist of any three members of the committee.

RECOMMENDED CLOSING TIME FOR BIDS

All subcontractors' bids are to be received by the depository not later than 3:00 P.M. and not less than six (6) calendar days prior to the closing of the general contractor bid as prescribed by the designer in the bid call and in the instructions to bidders. Bids received after prescribed closing time shall be stamped and returned unopened by the depository.

Recommended closing dates for the bid depository are Tuesday, Wednesday and Thursday, except when such date follows a statutory holiday.

#### PROCEDURE FOR SUBMITTING BIDS

All bids should be placed in official envelopes and on official forms obtained from the bid depository or designer. Three types of official envelopes should be used:

LARGE WHITE envelopes will contain the following small envelopes:

- (a) PINK envelope is for the general contractor and will contain a complete formal bid.
- (b) GREEN envelope is for the depository and will contain a copy of the bid, listing those general contractors intentionally omitted, if any.
- (c) The BID BOND, if required, should be enclosed in a large white envelope, separate from the pink and green envelopes.

Each filed sub-bid shall include only those sections or combined sections which are required by the designer, including all addenda issued from the designer's office 72 hours prior to sub-bid closing time. Sub-bids in any other form will be rejected by the owner.

#### PROCEDURE TO BE FOLLOWED BY DESIGNER

Designers shall insert in their specifications: "Sealed bids of subcontractors shall be filed in official envelopes and on official forms and deposited with the bid depository at the AGC office, Whitten Road, Box N, Augusta, Maine, no later than 3:00 P.M. (date). No bids will be accepted by the depository after that time. The sections of work that must be filed with the depository are: (List here the section(s) or combinations of sections, by section title and number.)

Designers shall clear the closing date with the depository.

Addenda affecting sub-trades filed with the depository shall be issued from the designer's office to all firms holding full or partial sets of plans, no later than 72 hours prior to sub-bid closing time.

#### PROCEDURE TO BE FOLLOWED BY SUBCONTRACTORS

On or before the time specified by the designer in the instructions to bidders, subcontractors shall deliver their sealed bids to the depository as follows:

A WHITE ENVELOPE SHALL CONTAIN:

- (a) Individual sealed PINK envelopes containing a bid proposal to each general contractor concerned, on official forms.
- (b) A GREEN envelope for the depository which will contain a copy of the bid, listing those general contractors intentionally omitted, if any.
- (c) A BID BOND, if required should be enclosed separately from the pink and green envelopes.

When requested, receipt shall be given for each WHITE envelope when deposited. Subcontractors may mail their sealed bids to the depository, but they do so at their own risk.

Subcontractors are responsible for reading the general conditions and the specifications thoroughly and must submit their bid in accordance with the bid document. The responsibility for checking with the designer on the existence of addenda and the content of same, rests solely with the subcontractor. Failure of the subcontractor to acknowledge addenda may result in the disqualification of his bid.

When a subcontractor has missed bidding to a general contractor, and if that subcontractor wishes to bid to that general contractor:

1. The subcontractor shall, not later than 24 hours prior to the closing date for the general contractor, notify the bid depository, in writing, as follows: "We missed bidding to (Black Construction) on ABC High School.) Please consider our bid addressed to (White Construction) as if it were submitted to Black Construction)
2. The subcontractor shall, after notifying the bid depository, advise (Black Construction.)

Any general contractor wishing to use it own forces for filed sub-bid work, shall follow general contractor procedures listed later in these regulations.

#### PROCEDURES TO BE FOLLOWED BY THE BID DEPOSITORY

Each depository box shall clearly designate the project, and the date and time of closing as stated by the designer in the bid documents. When large WHITE envelopes are presented for deposit prior to closing, they shall be stamped by a time clock showing the day, hour and minutes received and placed in the depository box. A receipt noting the number of the envelope will be handed to the firm representative when requested.

Late bids will be stamped and returned unopened by the depository.

Immediately after the closing time, the depository box shall be opened by an official representative of the depository and the WHITE envelopes removed and opened in the presence of any interested party.

The PINK envelopes will be picked up by the general contractor or a duly authorized representative. The depository may require the general contractor or representative to sign for envelopes when received. The depository may mail envelopes to the general contractor at his request, and his own risk and expense.

The GREEN envelopes shall be forwarded by the depository to the designer unless otherwise directed.

If bid bonds are required, they shall be forwarded by the depository with the GREEN envelopes.

#### AMENDMENTS TO BIDS

Written amendments to subcontractor bids which have been properly filed may be submitted to the bid depository provided that such amendments are received prior to the sub-bid closing time, and provided further that if the amendment discloses the amount of the subcontract price submitted, the proposal will be declared VOID.

#### WITHDRAWAL OF BID



Verified requests from subcontractors for withdrawal of bids will be accepted up to the time of sub-bid closing. Following the time of sub-bid closing, no such request will be considered until after the opening of the general contract bids.

#### PROCEDURES FOR GENERAL CONTRACTORS

A general contractor intending to use his own forces or a subsidiary company for one or more complete trade sections, shall deposit his bid in accordance with the regulations of the bid depository even if he bids only to himself. Such bid shall include a statement of the general contractor's qualifications to perform the work.

The general contractor should notify the bid depository of his intentions to bid a particular job. He should also advise subcontractors that he is bidding in order to assure that he receives a price for each filed trade.

The general contractor, when submitting his bid, will name his subcontractors, with a separate price carried for each trade, which must correspond with the copy received by the depository.

Any proposal submitted by a general contractor with a proposal for subcontractor's work which contains a price different from the proposal filed by that subcontractor, shall have the proposal amount filed substituted for the proposal amount carried and the proposal of the general contractor shall be adjusted by the difference prior to the selection of the general contractor.

#### INFORMATION FOR THE DESIGNER

For the convenience of the designer, the bid depository will provide, on request, information concerning scheduled bid closing to avoid conflicts at peak closing periods.

#### COMPLAINTS

Formal complaints relative to the administration of the filed bid system must be submitted, in writing, to the project owner or awarding authority, with a copy of the complaint submitted to the project designer. Upon receipt of the complaint, the owner or awarding authority may, before responding to the complaint, seek advice and counsel from the Bid Depository Advisory Committee, by contacting the committee through the AGC office at 622-4741.

SECTION 2-A  
NOTICE TO BUILDING CONTRACTORS  
(PUBLIC SCHOOL PROJECTS)  
LONG FORM  
(Advertisement)

Sealed proposals in envelopes plainly marked, Proposal For: Ocean Avenue Elementary School

Brief Job Description: The Work involves the construction of a new Elementary School, of approximately 68,500 square feet, at location indicated on Drawings. Work includes but is not limited to, earthwork, site utilities and site improvements, paving, and landscaping. Work also includes concrete foundations and slab-on-grade, steel structure, steel joists and decking, roof membrane over roof insulation, green roof system, sheet metal, masonry, metal stud partitions, insulation, gypsum board walls and ceilings, ceramic tile, acoustical ceilings, resilient flooring, carpeting, custom cabinets and fixtures, carpentry, glass storefront system, painting, metal doors, wood doors, metal frames, door hardware, overhead coiling doors, metal fabrications, toilet partitions and accessories, signage, lockers, fire protection and detection systems, security systems, electrical, and heating, ventilating, and air conditioning complete and ready for use.

Addressed to: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

will be opened and read aloud at \_\_\_\_\_ on Thursday, May 14, 2009. Bids received after 2 PM will not be considered and will be returned unopened.

General Contractors were required to pre-qualify for bidding on Friday, February 20, 2009. The pre-qualified General Contractors are as follows:

- |                                  |                                     |
|----------------------------------|-------------------------------------|
| 1) Wright-Ryan Construction Inc. | 9) Gilbane Building Co.             |
| 2) Davis & Hanscom               | 10) Bowman Bros.                    |
| 3) Ledgewood Construction        | 11) MacMillin Company, Inc.         |
| 4) The Sheridan Corp.            | 12) Cianbro                         |
| 5) Benchmark                     | 13) Arthur C. Dudley                |
| 6) P.J. Stella                   | 14) Ganneston Construction          |
| 7) Langford & Low, Inc.          | 15) Blane Casey Building Contractor |
| 8) Eckman Construction           | 16) PM Construction                 |

General contract proposals must be accompanied by a certified or cashier's check for 5% of the proposal or a satisfactory bid bond (2-C1) in a similar amount. The owner reserves the right to waive all formalities, and reject any and all proposals or to accept any proposal. Proposals shall be submitted upon the form provided by the architect.

The selected general contractor will be required to furnish a 100% contract performance bond and a 100% contract payment bond to cover the execution of the work which shall be in conformity with the form of bonds contained in section 2-C of the specifications and for the contract amount.

Subcontractors submitting proposals to General Contractors for work listed on general contractor's proposal form (2B-1) and the notice to contractors form (2-A), are required to send or deliver a copy of their proposals to the Maine Construction Bid Depository, 188 Whitten Road, PO Box 5519, Augusta, Maine 04332, and to be considered valid, must be received in the bid depository on or before

\_\_\_\_\_ 3 PM \_\_\_\_\_ on \_\_\_\_\_ Thursday, May 7, 2009 \_\_\_\_\_  
(Time) (Date)

in accordance with the Instructions to Bidders, Section 1-A, and the General Conditions and Regulations of the Maine Construction Bid Depository, on the form provided by the architect. No bids will be accepted by the Bid Depository after that time.

Subcontract proposals filed with the bid depository must be accompanied by a satisfactory bid bond, in conformity with the form of bond contained in Section 2-D1, made out to the Owner, for 5% of the sub-proposal amount, and filed separately in the WHITE envelope.

The selected subcontractors, required to file their sub-proposals with the bid depository, will also be required to furnish the selected general contractor with a 100% performance bond and a 100% payment bond, for their portion of the work, in conformity with the form of bonds contained in section 2-D2 and 2-D3.

Subcontractors required to file their sub-proposals and bid bonds with the bid depository are as follows: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Official forms and envelopes for sub-proposals may be obtained from either the architect, or the office of the Maine Construction Bid Depository, 188 Whitten Road, PO Box 5519, Augusta, Maine 04332.

On or about April 2, 2009 Contractors may obtain Plans, Specifications and addenda (if any), which will be made a part of the Contract from the FMC CADD, 75 Bishop Street Suite 3, Portland Maine 04103, phone (207) 878-8511, made payable to FMC CADD, upon non-refundable deposit (no cash accepted) of \$\_\_\_\_\_ per set (submitted in two (2) checks; one of \$\_\_\_\_\_ and one of \$\_\_\_\_\_), 5% sales tax included in this amount. Bidders returning drawings, specifications, and addenda in unmarked and in good condition within 10 days of the bid opening will receive a refund of \$\_\_\_\_\_ deposit. No partial sets will be issued.

Plans and Specifications may be examined at:

Associated General Contractors of Maine  
P.O. Box 5519, Whitten Road  
Augusta, Maine 04332-5519  
Tel: (207) 622-4741

City of Portland  
239 Park Avenue  
Portland, ME 04102

SECTION 2-B-1

PROPOSAL FORM FOR GENERAL CONTRACTORS  
(PUBLIC SCHOOL PROJECTS)

BIDDER: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

TO: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

A. Having carefully examined the form of contract, general conditions, special provisions and plans and specifications dated \_\_\_\_\_, Prepared by: \_\_\_\_\_ architect/engineer For \_\_\_\_\_ as well as the premises and conditions affecting the work, we the undersigned propose to furnish all labor, equipment, and materials necessary for and reasonably incidental to the construction and completion of this proposal for the amount of:

\$ \_\_\_\_\_

The above amount includes the following allowances: Refer to Section 012100

Allowance Item No. 1: Interior and Exterior Signs	\$ <u>15,000</u>
Allowance Item No. 2: Excess Utility Allowance	\$ <u>25,000</u>

B. Alternate prices as follows: Refer to Section 012300

Alternate No. 1: City Sewer Connection	Add	\$ _____
Alternate No. 2: Bleachers	Add	\$ _____
Alternate No. 3: Stage Curtains	Add	\$ _____
Alternate No. 4: Graffiti Protection	Add	\$ _____
Alternate No. 5: Upgraded Stage Lighting	Add	\$ _____
Alternate No. 6: Upgraded Phone System	Add	\$ _____

C. Unit Price Items: The undersigned agrees to perform additional work as ordered, or to allow for work ordered omitted, at the following prices which shall not vary by more than 10% and Deduct unit price shall be at least 90% of the add unit price: Refer to Section 012200

	Unit Price Item Additional Per Cu. Yd.	Unit Price Cost Omitted Per Cu. Yd.
1) Excavation and Removal	\$ _____	\$ _____
2) Excavation and Backfill (open)	\$ _____	\$ _____
3) Excavation and Backfill (trench)	\$ _____	\$ _____

4)	Rock Excavation and Removal (open)	\$ _____	\$ _____
5)	Rock Excavation and Removal (trench)	\$ _____	\$ _____
6)	Granular Borrow Fill	\$ _____	\$ _____
7)	Gravel Base	\$ _____	\$ _____
8)	Gravel Subbase	\$ _____	\$ _____
9)	Bio-Retention Bed Underdrain Material	\$ _____	\$ _____
10)	Bituminous Pavement HMA 12.5 mm (per ton)	\$ _____	\$ _____
11)	Bituminous Pavement HMA 19.0 mm (per ton)	\$ _____	\$ _____
12)	4" perforated Type B Underdrain (Lin. Ft.)	\$ _____	\$ _____
13)	12" corrugated Polyethylene pipe (Lin. Ft.)	\$ _____	\$ _____
14)	Impervious Pond Liner (Sq. Ft.)	\$ _____	\$ _____

C. This proposal includes the following addenda to the plans and specifications:

Addendum No. \_\_\_\_\_, Dated \_\_\_\_\_ Addendum No. \_\_\_\_\_, Dated \_\_\_\_\_

Addendum No. \_\_\_\_\_, Dated \_\_\_\_\_ Addendum No. \_\_\_\_\_, Dated \_\_\_\_\_

Addendum No. \_\_\_\_\_, Dated \_\_\_\_\_ Addendum No. \_\_\_\_\_, Dated \_\_\_\_\_

D. Filed subcontract proposals as follows: (List those trades required, but do not combine trades except as called for)

<u>Trade</u>	<u>Name of Subcontractor</u>	<u>Amount</u>
_____	_____	\$ _____
_____	_____	\$ _____
_____	_____	\$ _____
_____	_____	\$ _____

The undersigned agrees that each of the above named subcontractors represents a bonafied SUBPROPOSAL based on the plans and specifications and will be used for the work indicated at the amount stated, unless a substitution is made by mutual agreement as provided for in section 1, paragraph 6, "Instructions to Bidders". In the event alternate prices are requested and various trades are involved, the general contractor may use properly filed subproposals even though a change in subcontractors from those carried in his base proposal may occur. If he does use different subcontractors because of alternates, he shall use supplemental sheets attached to the proposal form (2-B1) to indicate such changes.

E. The undersigned agrees, if this proposal is accepted, to sign a contract and deliver it, along with the bonds and affidavits of all insurance specified within twelve (12) calendar days after the date of notification of such acceptance, except if the 12th day falls on a holiday, a Saturday or Sunday, then the conditions will be fulfilled if the required documents are received before 12 o'clock noon on the day following the holiday, or the Monday following the Saturday or Sunday, and as a guarantee thereof, herewith submits a certified or cashier's check or bid bond as required.

The undersigned agrees, if awarded the contract, to complete the work on or before \_\_\_\_\_.

This proposal includes the cost of a 100% performance bond and a 100% payment bond.

Signed \_\_\_\_\_

By \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_

NOTE: If bidder is a corporation, write State of incorporation, and if a partnership, give full names of all partners.

2-B2  
 MAINE CONSTRUCTION BID DEPOSITORY  
 (PUBLIC SCHOOL PROJECTS)  
 PROPOSAL FORM FOR SUBCONTRACTORS  
 LONG FORM

To: \_\_\_\_\_

For green envelope copy, list any general contractor(s) excluded from your bid.

PROJECT: \_\_\_\_\_

SECTION(S) QUOTED: \_\_\_\_\_

PRICE QUOTED: SECTION \_\_\_\_\_ \$ \_\_\_\_\_ SECTION \_\_\_\_\_ \$ \_\_\_\_\_

TOTAL COMBINED PRICE (if applicable) SECTIONS \_\_\_\_\_ \$ \_\_\_\_\_

A. The undersigned propose to furnish all labor and materials required for completing in accordance with the hereinafter described plans, specifications general conditions and addenda, all the work specified in the above stated section(s) of the specifications and contract drawings dated \_\_\_\_\_.

Prepared by \_\_\_\_\_ architect/engineer.

B. Alternate prices are submitted as follows: (Use separate sheets as necessary).

Alternate No. 1: City Sewer Connection	Add	\$ _____
Alternate No. 2: Bleachers	Add	\$ _____
Alternate No. 3: Stage Curtains	Add	\$ _____
Alternate No. 4: Graffiti Protection	Add	\$ _____
Alternate No. 5: Upgraded State Lighting	Add	\$ _____
Alternate No. 6: Upgraded Phone System	Add	\$ _____

C. The subcontract proposal includes the following addenda to the drawings and specifications: (List addenda and issue date of each).

\_\_\_\_\_

D. The undersigned agrees that, if he is selected as a subcontractor, he will execute with the selected general contractor a subcontract in accordance with the terms of this subproposal, and furnish the general contract with a 100% performance bond and a 100% payment bond for his portion of the work.

E. \_\_\_\_\_ License # (if applicable) \_\_\_\_\_

(Firm Name of Sub-bidder)

Signed by: \_\_\_\_\_ Date \_\_\_\_\_

Address \_\_\_\_\_

Street

City

State

Zip

F. All foreign corporations intending to do business in Maine must comply with the provisions of 13A M.R.S.A., Chapter 12 and shall contact the Secretary of State for compliance.

SECTION 2-C1  
SHORT FORM  
FORM OF GENERAL CONTRACT BID BOND  
(Public School Projects)

KNOW ALL MEN BY THESE PRESENTS, THAT WE, THE UNDERSIGNED (1) \_\_\_\_\_  
\_\_\_\_\_, (2) \_\_\_\_\_  
OF \_\_\_\_\_ AND STATE OF \_\_\_\_\_  
AS PRINCIPAL AND (3) \_\_\_\_\_  
AS SURETY, ARE HEREBY HELD AND FIRMLY BOUND UNTO (4) \_\_\_\_\_  
\_\_\_\_\_ IN THE PENAL SUM OF \_\_\_\_\_  
FOR THE PAYMENT OF WHICH, WELL AND TRULY TO BE MADE, WE HEREBY JOINTLY  
AND SEVERALLY BIND OURSELVES, OUR HEIRS, EXECUTORS, ADMINISTRATORS,  
SUCCESSORS AND ASSIGNS, SIGNED THIS (5) \_\_\_\_\_ DAY OF \_\_\_\_\_ 20\_\_\_\_\_.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT WHEREAS THE  
PRINCIPAL HAS SUBMITTED TO (6) OWNER \_\_\_\_\_  
\_\_\_\_\_  
A CERTAIN PROPOSAL, ATTACHED HERETO AND HEREBY MADE A PART HEREOF, TO  
ENTER INTO A CONTRACT IN WRITING, FOR THE CONSTRUCTION OF (7) \_\_\_\_\_  
\_\_\_\_\_

NOW THEREFORE:

(A) IF SAID PROPOSAL SHALL BE REJECTED, OR, IN THE ALTERNATE,  
(B) IF SAID PROPOSAL SHALL BE ACCEPTED AND THE PRINCIPAL SHALL  
EXECUTE AND DELIVER A CONTRACT IN THE FORM OF CONTRACT ATTACHED  
HERETO (PROPERLY COMPLETED IN ACCORDANCE WITH SAID PROPOSAL) AND SHALL  
FURNISH A BOND FOR HIS FAITHFUL PERFORMANCE OF SAID CONTRACT, AND FOR  
THE PAYMENT OF ALL PERSONS PERFORMING LABOR OR FURNISHING MATERIAL IN  
CONNECTION THEREWITH, AND SHALL IN ALL OTHER RESPECTS PERFORM THE  
AGREEMENT CREATED BY THE ACCEPTANCE OF SAID PROPOSAL, THEN THIS  
OBLIGATION SHALL BE VOID, OTHERWISE THE SAME SHALL REMAIN IN FORCE AND  
EFFECT: IT BEING EXPRESSLY UNDERSTOOD AND AGREED THAT THE  
LIABILITY OF THE SURETY FOR ANY AND ALL CLAIMS HEREUNDER SHALL, IN NO



EVENT, EXCEED THE PENAL AMOUNT OF THIS OBLIGATION AS HEREIN STATED.

THE SURETY, FOR VALUE RECEIVED HEREBY STIPULATES AND AGREES THAT THE OBLIGATION OF SAID SURETY AND ITS BOND SHALL BE IN NO WAY IMPAIRED OR AFFECTED BY ANY EXTENSION OF TIME WITHIN WHICH THE PRINCIPAL MAY ACCEPT SUCH PROPOSAL: AND SAID SURETY DOES HEREBY WAIVE NOTICE OF ANY SUCH EXTENSION.

IN WITNESS WHEREOF, THE PRINCIPAL AND THE SURETY HAVE HEREUNTO SET THEIR HANDS AND SEALS, AND SUCH OF THEM AS ARE CORPORATIONS HAVE CAUSED THEIR CORPORATE SEALS TO BE HERETO AFFIXED AND THESE PRESENTS TO BE SIGNED BY THEIR PROPER OFFICES, THE DAY AND YEAR FIRST SET ABOVE.

SIGNED AND SEALED THIS (5) \_\_\_\_\_ DAY OF \_\_\_\_\_ 20\_\_.

WITNESS: \_\_\_\_\_ CONTRACTOR: \_\_\_\_\_

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

WITNESS: \_\_\_\_\_ SURETY: \_\_\_\_\_

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

APPROVED AS TO FORM \_\_\_\_\_, 20\_\_.

BY \_\_\_\_\_

(Owner's Attorney)

Legend

- (1) Correct name of contractor.
- (2) A corporation, a partnership, or an individual, as the case may be.
- (3) Correct name of surety.
- (4) Treasurer of the municipality or school administrative district, as the case may be.
- (5) Same date as that of proposal.
- (6) Owner shall be the municipality or school administrative district, as the case may be.
- (7) Name of project as designated in the contract documents.

If contractor is a partnership, all partners should execute bond. A power of attorney document, together with a statement that it still is in full force and effect shall be provided by the person executing this bond.

SECTION 2-C2

LONG FORM  
FORM OF GENERAL CONTRACT PERFORMANCE BOND  
(Public School Projects)

KNOW ALL MEN BY THESE PRESENTS THAT (1) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
(2) \_\_\_\_\_  
OF \_\_\_\_\_ AND STATE OF \_\_\_\_\_  
AS PRINCIPAL, AND (3) \_\_\_\_\_  
A CORPORATION DULY ORGANIZED UNDER THE LAWS OF THE STATE OF \_\_\_\_\_  
AND HAVING A USUAL PLACE OF BUSINESS IN \_\_\_\_\_ AS  
SURETY, ARE HELD AND FIRMLY BOUND UNTO THE (4) \_\_\_\_\_  
AS OBLIGEE, IN THE PENAL SUM OF \_\_\_\_\_ DOLLARS  
(\$ \_\_\_\_\_), TO BE PAID SAID \_\_\_\_\_  
OR HIS SUCCESSORS IN OFFICE, FOR WHICH PAYMENT WELL AND TRULY TO BE MADE,  
PRINCIPAL AND SURETY BIND THEMSELVES, THEIR HEIRS, EXECUTORS AND  
ADMINISTRATORS, SUCCESSORS AND ASSIGNS, JOINTLY AND SEVERALLY BY THESE  
PRESENTS.

THE CONDITION OF THIS OBLIGATION IS SUCH THAT IF THE PRINCIPAL SHALL  
PROMPTLY AND FAITHFULLY PERFORM THE CONTRACT ENTERED INTO ON THE  
(5) \_\_\_\_\_ DAY OF \_\_\_\_\_ A.D. 20\_\_\_\_ FOR THE  
CONSTRUCTION OF (6) \_\_\_\_\_

\_\_\_\_\_  
THEN THIS OBLIGATION SHALL BE NULL AND VOID: OTHERWISE IT SHALL REMAIN IN  
FULL FORCE AND EFFECT.

THE SURETY HEREBY WAIVES NOTICE OF ANY ALTERATION OR EXTENSION OF  
TIME MADE BY THE (7) OWNER.

SIGNED AND SEALED THIS (5) \_\_\_\_\_ DAY OF \_\_\_\_\_ 20\_\_\_\_\_

WITNESSES: \_\_\_\_\_ CONTRACTOR \_\_\_\_\_

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

WITNESSES: \_\_\_\_\_ SURETY: \_\_\_\_\_

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

APPROVED AS TO FORM \_\_\_\_\_, 20\_\_\_\_\_.

BY \_\_\_\_\_  
(Owner's Attorney)

Legend

- (1) Correct name of contractor.
- (2) A corporation, a partnership, or an individual, as the case may be.
- (3) Correct name of surety.
- (4) Treasurer of the State of Maine.
- (5) Same date as that of contract.
- (6) Name of project as designated in contract documents.
- (7) Owner shall be the State of Maine.

If contractor is a partnership, all partners should execute bond. A power of attorney document, together with a statement that it still is in full force and effect shall be provided by the person executing this bond. Bond must be countersigned by a Resident Maine Agent.

SECTION 2-C3

SHORT FORM  
FORM OF GENERAL CONTRACT PAYMENT BOND  
(Public School Projects)

KNOW ALL MEN BY THESE PRESENTS THAT (1) \_\_\_\_\_  
 \_\_\_\_\_ (2) \_\_\_\_\_  
 OF \_\_\_\_\_ AND STATE OF \_\_\_\_\_  
 AS PRINCIPAL AND (3) \_\_\_\_\_  
 A CORPORATION DULY ORGANIZED UNDER THE LAWS OF THE STATE OF \_\_\_\_\_  
 AND HAVING A USUAL PLACE OF BUSINESS IN \_\_\_\_\_ AS SURETY ARE HELD  
 AND FIRMLY BOUND UNTO THE (4) \_\_\_\_\_ IN THE SUM OF  
 \_\_\_\_\_ DOLLARS, (\$ \_\_\_\_\_) FOR THE USE  
 AND BENEFITS OF CLAIMANTS\* AS HEREIN BELOW DEFINED, THE PAYMENT  
 WHEREOF PRINCIPAL AND SURETY BIND THEMSELVES, THEIR HEIRS, EXECUTORS AN  
 ADMINISTRATORS, SUCCORS AND ASSIGNS, JOINTLY AND SEVERALLY BY THESE  
 PRESENTS. THE CONDITION OF THIS OBLIGATION IS SUCH THAT IF THE PRINCIPAL  
 SHALL PROMPTLY SATISFY ALL CLAIMS AND DEMANDS INCURRED FOR ALL LABOR  
 AND MATERIAL, USED OR REQUIRED BY HIM IN CONNECTION WITH THE WORK  
 CONTEMPLATED IN THE CONTRACT ENTERED INTO ON THE (5) \_\_\_\_\_ DAY  
 OF \_\_\_\_\_ A.D. 20\_\_\_\_ FOR THE CONSTRUCTION OF (6) \_\_\_\_\_  
 \_\_\_\_\_, AND SHALL FULLY REIMBURSE THE  
 OBLIGEE FOR ALL OUTLAY AND EXPENSE WHICH SAID OBLIGEE MAY INCUR IN  
 MAKING GOOD ANY DEFAULT OF SAID PRINCIPAL, THEN THIS OBLIGATION BE NULL  
 AND VOID: OTHERWISE, IT SHALL REMAIN IN FULL FORCE AND EFFECT.

\* A claimant is defined as one having a direct contract with the principal or with a subcontractor of the principal for labor, material, or both, used or reasonably required for use in the performance of the contract.

SIGNED AND SEALED THIS (5)\_\_\_\_\_ DAY OF \_\_\_\_\_ 20\_\_\_\_\_

WITNESSES: \_\_\_\_\_ CONTRACTOR: \_\_\_\_\_

\_\_\_\_\_ BY \_\_\_\_\_ (L.S.)

\_\_\_\_\_ BY \_\_\_\_\_ (L.S.)

\_\_\_\_\_ BY \_\_\_\_\_ (L.S.)

WITNESSES: \_\_\_\_\_ SURETY \_\_\_\_\_ (L.S.)

\_\_\_\_\_ BY \_\_\_\_\_ (L.S.)

\_\_\_\_\_ BY \_\_\_\_\_ (L.S.)

APPROVED AS TO FORM \_\_\_\_\_, 20\_\_\_\_\_.

BY \_\_\_\_\_

(Owner's Attorney)

Legend

- (1) Correct name of contractor.
- (2) A corporation, a partnership, or an individual, as the case may be.
- (3) Correct name of surety.
- (4) Treasurer of the municipality or school administrative district, as the case may be.
- (5) Same date as that of contract.
- (6) Name of project as designated in the contract documents.

If the contractor is partnership, all partners should execute bond. A power of attorney document, together with a statement that it still is in full force and effect shall be provided by the person executing this bond.

SECTION 2-D1  
FORM OF SUBCONTRACTORS BID BOND  
(Public School Projects)  
LONG FORM

KNOW ALL MEN BY THESE PRESENTS, THAT WE, THE UNDERSIGNED,

(1) \_\_\_\_\_

\_\_\_\_\_ AND STATE OF \_\_\_\_\_

AS PRINCIPAL, AND (3) \_\_\_\_\_ AS

SURETY, ARE HEREBY HELD AND FIRMLY BOUND UNTO (4) \_\_\_\_\_

\_\_\_\_\_ AS OBLIGEE, IN THE PENAL SUM OF \_\_\_\_\_

FOR PAYMENT OF WHICH, WELL AND TRULY TO BE MADE, WE HEREBY JOINTLY AND

SEVERALLY BIND OURSELVES, OUR HEIRS, EXECUTORS, ADMINISTRATORS,

SUCCESSORS, AND ASSIGNS, SIGNED THIS (5) \_\_\_\_\_ DAY OF \_\_\_\_\_ 20\_\_\_\_\_.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT WHEREAS THE

PRINCIPAL HAS SUBMITTED TO THE OBLIGEE A CERTAIN SUBPROPOSAL, ATTACHED

HERETO AND HEREBY MADE A PART HEREOF, TO ENTER INTO A SUBCONTRACT IN

WRITING, FOR THE CONSTRUCTION OF (6) \_\_\_\_\_

WITH ANY GENERAL CONTRACTOR LISTED IN SAID PROPOSAL, PROVIDED THE

DESIGNATED GENERAL CONTRACTOR HAS ENTERED INTO A WRITTEN CONTRACT

WITH THE OWNER.

NOW THEREFORE:

- (a) IF SAID SUBPROPOSAL SHALL BE REJECTED, OR IN THE ALTERNATE,
- (b) IF SAID SUBPROPOSAL SHALL BE ACCEPTED AND THE PRINCIPAL SHALL EXECUTE AND DELIVER A SUBCONTRACT TO THE GENERAL CONTRACTOR DESIGNATED BY THE OWNER IN THE FORM OF SUBCONTRACT ATTACHED HERETO (PROPERLY COMPLETED IN ACCORDANCE WITH SAID SUBPROPOSAL) AND SHALL FURNISH BONDS FOR HIS FAITHFUL PERFORMANCE OF SAID SUBCONTRACT, AND FOR

THE PAYMENT OF ALL PERSONS PERFORMING LABOR OR FURNISHING MATERIAL IN CONNECTION THEREWITH, AND SHALL IN ALL OTHER RESPECTS PERFORM THE AGREEMENT CREATED BY THE ACCEPTANCE OF SAID SUBPROPOSAL,

THEN THIS OBLIGATION SHALL BE VOID, OTHERWISE THE SAME SHALL REMAIN IN FULL FORCE AND EFFECT: IT BEING EXPRESSLY UNDERSTOOD AND AGREED THAT THE LIABILITY OF THE SURETY FOR ANY AND ALL CLAIMS HEREUNDER SHALL IN NO EVENT, EXCEED THE PENAL AMOUNT OF THIS OBLIGATION AS HEREIN STATED. THE SURETY, FOR VALUE RECEIVED, HEREBY STIPULATES AND AGREES THAT THE OBLIGATION OF SAID SURETY AND ITS BOND SHALL IN NO WAY BE IMPAIRED OR AFFECTED BY ANY EXTENSION OF THE TIME WITHIN WHICH THE PRINCIPAL MAY ACCEPT SUCH PROPOSAL AND SAID SURETY DOES HEREBY WAIVE NOTICE OF ANY SUCH EXTENSION. IN WITNESS WHEREOF, THE PRINCIPAL AND THE SURETY HAVE HEREUNTO SET THEIR HANDS AND SEALS, AND SUCH OF THEM AS ARE CORPORATIONS HAVE CAUSED THEIR CORPORATE SEALS TO BE HEREUNTO AFFIXED AND THESE PRESENTS TO BE SIGNED BY THEIR PROPER OFFICERS, THE DAY AND YEAR FIRST SET ABOVE.

SIGNED AND SEALED THIS (5) \_\_\_\_\_ DAY OF \_\_\_\_\_ 20 \_\_\_\_.

WITNESS: \_\_\_\_\_ SUBCONTRACTOR: \_\_\_\_\_

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

WITNESS: \_\_\_\_\_ SURETY: \_\_\_\_\_

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

APPROVED AS TO FORM \_\_\_\_\_

By \_\_\_\_\_

(Owner's Attorney)

Legend

- (1) Correct name of subcontractor.
- (2) A corporation, a partnership, or an individual, as the case may be.
- (3) Correct name of surety.
- (4) Treasurer of the municipality or school administrative district, as the case may be.
- (5) Same date as that of SUBPROPOSAL.
- (6) Name of project as designated in contract documents.

If subcontractor is partnership, all partners should execute bond. A power of attorney document, together with a statement that it still is in full force and effect shall be provided by the person executing this bond.



SECTION 2-D2  
LONG FORM  
FORM OF SUBCONTRACT PERFORMANCE BOND  
(Public School Projects)

KNOW ALL MEN BY THESE PRESENTS THAT (1) \_\_\_\_\_  
\_\_\_\_\_,(2) \_\_\_\_\_  
OF \_\_\_\_\_ AND STATE OF \_\_\_\_\_ AS  
PRINCIPAL, AND (3) \_\_\_\_\_  
A CORPORATION DULY ORGANIZED UNDER THE LAWS OF THE STATE OF \_\_\_\_\_  
AND HAVING A USUAL PLACE OF BUSINESS IN \_\_\_\_\_ AS  
SURETY, ARE HELD AND FIRMLY BOUND UNTO THE (4) \_\_\_\_\_ AS  
OBLIGEE, TO BE PAID SAID (4) \_\_\_\_\_  
OR HIS ASSIGNS, FOR WHICH PAYMENT WELL AND TRULY TO BE MADE, PRINCIPAL  
AND SURETY BIND THEMSELVES, THEIR HEIRS, EXECUTORS AN ADMINISTRATORS,  
SUCCESSORS AND ASSIGNS, JOINTLY AND SEVERALLY BY THESE PRESENTS.

THE CONDITION OF THIS OBLIGATION IS SUCH THAT IF THE PRINCIPAL SHALL  
PROMPTLY AND FAITHFULLY PERFORM THE SUBCONTRACT ENTERED INTO ON THE  
(5) \_\_\_\_\_ DAY OF \_\_\_\_\_ A.D. 20 \_\_\_\_\_  
FOR THE CONSTRUCTION OF (6) \_\_\_\_\_  
\_\_\_\_\_

THEN THIS OBLIGATION SHALL BE NULL AND VOID: OTHERWISE, IT SHALL REMAIN  
IN FULL FORCE AND EFFECT.

THE SURETY HEREBY WAIVES NOTICES OF ANY ALTERATION OR EXTENSION OF  
TIME MADE BY THE OWNER AND GENERAL CONTRACTOR.

SIGNED AND SEALED THIS (5) \_\_\_\_\_ DAY OF \_\_\_\_\_ 20\_\_\_\_.

WITNESS: \_\_\_\_\_ SUBCONTRACTORS: \_\_\_\_\_

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

WITNESS: \_\_\_\_\_ SURETY: \_\_\_\_\_

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

APPROVED AS TO FORM \_\_\_\_\_, 20\_\_\_\_.

BY \_\_\_\_\_  
(Owner's Attorney)

Legend

- (1) Correct name of subcontractor.
- (2) A corporation, a partnership, or an individual, as the case may be.
- (3) Correct name of surety.
- (4) General contractor.
- (5) Same date as that of subcontract.
- (6) Name of project as designated in contract documents.

If subcontractor is a partnership, all partners should execute bond. A power of attorney document, together with a statement that it still is in full force and effect shall be provided by the person executing this bond. Bond must be countersigned by a resident Maine agent.

SECTION 2-D3  
LONG FORM  
FORM OF SUBCONTRACT PAYMENT BOND  
(Public School Projects)

KNOW ALL MEN BY THESE PRESENTS THAT (1) \_\_\_\_\_  
\_\_\_\_\_  
(2) \_\_\_\_\_  
OF \_\_\_\_\_ AND STATE OF \_\_\_\_\_  
AS PRINCIPAL AND (3) \_\_\_\_\_  
A CORPORATION DULY ORGANIZED UNDER THE LAWS OF THE STATE OF \_\_\_\_\_  
AND HAVING A USUAL PLACE OF BUSINESS IN \_\_\_\_\_ AS SURETY ARE HELD  
AND FIRMLY BOUND UNTO THE (4) \_\_\_\_\_ AS OBLIGEE, IN THE PENAL  
SUM OF \_\_\_\_\_ DOLLARS, (\$ \_\_\_\_\_) FOR THE  
USE AND BENEFIT OF CLAIMANTS\* AS HEREIN BELOW DEFINED, FOR THE PAYMENT  
WHEREOF PRINCIPAL AND BIND THEMSELVES, THEIR HEIRS, EXECUTORS AND  
ADMINISTRATORS, SUCCESSORS AND ASSIGNS, JOINTLY AND SEVERALLY BY THESE  
PRESENTS.

THE CONDITION OF THIS OBLIGATION IS SUCH THAT IF THE PRINCIPAL SHALL  
PROMPTLY SATISFY ALL CLAIMS AND DEMANDS INCURRED FOR ALL LABOR AND  
MATERIALS, USED OR REQUIRED BY HIM IN CONNECTION WITH THE WORK  
CONTEMPLATED IN THE SUBCONTRACT ENTERED INTO ON THE (5) \_\_\_\_\_ DAY OF  
\_\_\_\_\_ A.D. 20\_\_\_\_ FOR THE CONSTRUCTION OF (6) \_\_\_\_\_,  
\_\_\_\_\_, AND SHALL  
FULLY REIMBURSE THE OBLIGEE FOR ALL OUTLAY AND EXPENSE WHICH SAID  
OBLIGEE MAY INCUR IN MAKING GOOD ANY DEFAULT OF SAID PRINCIPAL, THEN THIS  
OBLIGATION SHALL BE NULL AND VOID: OTHERWISE, IT SHALL REMAIN IN FULL  
FORCE AND EFFECT.

\* A claimant is defined as one having a direct contract with the principal or with a subcontractor of one of the principal for labor, material or both, used or reasonably required for use in the performance of the subcontract.

Signed and sealed this (5)\_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_\_

WITNESS: \_\_\_\_\_ SUBCONTRACTORS: \_\_\_\_\_

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

WITNESS: \_\_\_\_\_ SURETY: \_\_\_\_\_

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

\_\_\_\_\_ By \_\_\_\_\_ (L.S.)

APPROVED AS TO FORM \_\_\_\_\_, 20\_\_\_\_\_.

BY \_\_\_\_\_

(Owner's Attorney)

Legend

- (1) Correct name of subcontractor.
- (2) A corporation, a partnership, or an individual, as the case may be.
- (3) Correct name of surety.
- (4) General contractor.
- (5) Same date as that of subcontract.
- (6) Name of project as designated in contract documents.

If subcontractor is partnership, all partners should execute bond. A power of attorney document, together with a statement that it still is in full force and effect shall be provided by the person executing the bond.

SECTION 2-E  
PUBLIC SCHOOL PROJECT  
CONTRACT AGREEMENT

THIS AGREEMENT made the \_\_\_\_\_ day of \_\_\_\_\_ in the year Two Thousand and \_\_\_\_\_ by and between the

\_\_\_\_\_ hereinafter called the Owner and \_\_\_\_\_

\_\_\_\_\_ hereinafter called the contractor.

WITNESSETH,

That the owner and the contractor for the considerations hereinafter named agree as follows:

ARTICLE 1. SCOPE OF WORK

The contractor shall furnish all of the materials and perform all the work shown on the plans and described in the specifications entitled

\_\_\_\_\_  
Prepared by \_\_\_\_\_

acting as and in these contract documents entitled the architect and/or engineer, and shall do everything required by this agreement, the general conditions and special provisions of the contract, the specifications and the drawings.

ARTICLE 2. TIME OF COMPLETION

The work to be performed under this contract shall be completed on or before \_\_\_\_\_.  
For each calendar day the project remains uncompleted \_\_\_\_\_ shall be charged as liquidated damages.

ARTICLE 3. THE CONTRACT SUM

The owner shall pay the contractor for the performance of the contract, subject to additions and deductions provided by approved change orders in current funds as follows \_\_\_\_\_ (\$ \_\_\_\_\_)

ARTICLE 4. CONTRACT BONDS

The contractor shall furnish the owner the approved contract bonds (as per article 27 of the standard general conditions) in the amount of 100% of the contract amount.

#### ARTICLE 5. PROGRESS PAYMENTS

The owner shall make payments on account of the contract as provided therein as follows: Each month 95% of the value, based on contract prices of labor and materials incorporated in the work and of materials suitably stored at the site thereof up to the first day of that month, as certified by the architect and/or engineer.

The owner may cause the contractor to be paid such portion of the amount retained hereunder as he deems advisable. (See Article 24 of the Standard General Conditions Section 3-A).

#### ARTICLE 6. FINAL PAYMENT

Final payment shall be due 60 days after completion and acceptance of the work, provided the contractor has submitted evidence satisfactory to the owner that all payrolls, material bills and other indebtedness connected with the work has been paid.

#### ARTICLE 7. THE CONTRACT DOCUMENTS

The general conditions of the contract, instructions to bidders, the proposal, the special provisions, the specifications and the drawings, together with this agreement form the contract, and they are as fully a part of the contract as if hereto attached or herein repeated. The following is an enumerations of the specifications and the drawings.

#### SPECIFICATIONS:

#### ADDENDA:

#### DRAWINGS:

The owner and the contractor hereby agree to the full performance of the covenants herein.

IN WITNESS WHEREOF the parties hereto have executed this agreement in \_\_\_\_\_  
the day and year first above written.

\_\_\_\_\_  
(Contractor)

WITNESS:

\_\_\_\_\_

BY: \_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Local School Unit Name)

WITNESS:

\_\_\_\_\_

BY: \_\_\_\_\_  
(Signature)

APPROVED BY: \_\_\_\_\_  
Bureau of General Services

SECTION 2-E1

STATE OF MAINE

SUBCONTRACT AGREEMENT  
(Public School Projects)

THIS AGREEMENT made the \_\_\_\_\_ day of \_\_\_\_\_ in the year  
Nineteen Hundred and \_\_\_\_\_ by and between \_\_\_\_\_  
\_\_\_\_\_ hereinafter called the contractor and \_\_\_\_\_  
\_\_\_\_\_ hereinafter called the subcontractor.

WITNESSETH

That the contractor and the subcontractor for the considerations hereinafter called named agrees  
follows:

ARTICLE 1. SCOPE OF THE WORK

The subcontractor shall furnish all of the materials and perform all of the work shown on the plans  
and described in the specifications entitled sections quoted:

\_\_\_\_\_ ; \_\_\_\_\_ ; \_\_\_\_\_ ;

Prepared by \_\_\_\_\_  
acting as and in these contract documents entitled the architect and shall do everything required by this  
agreement, the general conditions and special provisions of the contract, the specifications and the  
drawings.

ARTICLE 2. TIME OF COMPLETION

The work to be performed under this contract shall start on or before \_\_\_\_\_  
and will be completed in accordance with established construction schedule.

ARTICLE 3. THE CONTRACT SUM

The contractor shall pay the subcontractor for the performance of the subcontract, subject to  
additions and deductions provided therein, in current funds as follows \_\_\_\_\_

\_\_\_\_\_ (\$ \_\_\_\_\_).

ARTICLE 4. CONTRACT BOND

The subcontractor shall furnish the contractor the approved subcontract bonds (as per Article 27 of  
the standard general conditions) in the amount of 100% of the subcontract sum.

ARTICLE 5. PROGRESS PAYMENTS



The contractor shall make payments on account of the subcontract as provided herein as follows: each month 95% of the value, based on schedule of prices for labor and materials incorporated in the work and of materials suitably stored at the site thereof up to the first day of that month, as certified by the architect.

The contractor may cause subcontractor to be paid such portion of the amount retained hereunder in accordance with Article 24 of the general conditions, as the owner may approve.

#### ARTICLE 6. FINAL PAYMENT

Final payment shall be due sixty (60) days after completion and acceptance of the work, provided the subcontractor has submitted evidence satisfactory to the contractor and the owner that all payrolls, material bills and other indebtedness connected with the work has been paid.

#### ARTICLE 7. THE CONTRACT DOCUMENTS

The general conditions of the contract, instructions to bidders, the subproposal, the special provisions, the specifications and the drawings, together with this agreement form the contract, and they are as fully a part of the contract as if hereto attached or herein repeated. The following is an enumeration of the specifications and the plans.

#### ARTICLE 8. Temporary Site Facilities & Job Conditions

#### ARTICLE 9. Amendments to Subcontract Agreement

#### SPECIFICATIONS:

Sections

#### PLANS:

#### ADDENDA:

The contractor and the subcontractor hereby agree to the full performance of the covenants herein.

IN WITNESS WHEREOF the parties hereto have executed this agreement in \_\_\_\_\_ the day and year first above written.

\_\_\_\_\_  
(Subcontractor)

WITNESS:

BY: \_\_\_\_\_

(TITLE)

\_\_\_\_\_  
(Contractor)

WITNESS:

BY: \_\_\_\_\_

(TITLE)

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SECTION 3-A

STATE OF MAINE

STANDARD GENERAL CONDITIONS  
AND  
CONTRACT WORK

For

PUBLIC SCHOOL PROJECTS

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October 17, 1988  
Rev. 12/21/92; 4/20/99, 11/08/01

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**ARTICLE 1. DEFINITIONS**

Whenever the following terms are used in these specifications or the contract, the intent and meaning shall be interpreted as follows:

Designer: The project Architect and/or Engineer whose name appears on the plans and/or specifications for the project, acting directly or through an authorized representative.

Bid Security: The security designated in the proposal, furnished by bidders as a guaranty of good faith to enter into a contract with the state, should a contract be awarded to that bidder.

Bidder: Any individual, partnership, or corporation submitting a proposal for the performance of the work described under the terms of the contract, acting directly or through a duly authorized representative.

Bureau: The Bureau of General Services.

Calendar Days: Consecutive days, as occurring on a calendar, taking into account the day of the week, month, year, and any religious, national or local holidays.

Change Order: A written agreement between the Owner and the Contractor, operating as a supplement to the contract, covering correction of: omissions, errors, and discrepancies between the plans and the proposal or estimates; or any alterations in the plans; or additional requirements; work, materials, and incidentals required to complete the construction of the project in an acceptable manner, and setting forth the basis of compensation for that supplemental work, if any. Before any change order modifies or becomes a part of the work, it must be duly signed by the Contractor, and the Owner, and approved by the Bureau of General Services and the Designer.

Clerk of the Works: The authorized representative of the Designer.

Contract: A written agreement between the Owner and the successful bidder, by which the Contractor is bound to perform the work specified, in accordance with plans, specifications, general conditions, and special provisions, that are a part of the contract documents, together with all supplemental agreements by which the Owner is bound to compensate the Contractor at mutually established and accepted rates or prices.

Contract Bond: The approved forms of security furnished by the Contractor and his surety, or sureties, which guarantee the faithful performance of all the terms of the contract and the payment of all bills, for labor, materials and equipment by the Contractor.

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Contract Documents: The contract documents consist of the contract, general conditions, special provisions, the plans and specifications including all addenda, change orders, and all other modifications thereof, that were incorporated in the documents subsequent to their execution.

Contractor: The individual, partnership, or corporation undertaking the execution of the general contract work under the terms of the contract with the Owner, acting directly or through a duly authorized representative.

Director of the Bureau of General Services: The State Director of the Bureau of General Services or his/her duly authorized representative.

Final Completion: The stage of the Work when the Work has been fully completed in accordance with the terms and conditions of the Contract Documents.

Owner: School Administrative Unit, acting through its duly authorized representative.

Owner's Representative:

Plans: All official drawings or reproductions of drawings pertaining to the work provided for in the contract and such working plans as may be furnished or approved by the Owner or Designer from time to time.

Project: The entire improvement proposed by the Owner to be constructed in part or in whole pursuant to these specifications and contract documents. Where the word "Job" appears it shall mean the project.

Proposal or Bid: The written offer of the bidder, on a form prescribed to perform the work specified.

Provide: The word "provide" shall mean, "furnish and install," including connections to services if required, unless specified otherwise.

Sub-Contractor: The individual, the firm or corporation undertaking the execution of any part of the work under the terms of the contract by virtue of a written agreement between itself and the Contractor.

Substantial Completion: The stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilize the Work for its intended use. Minor corrections and repairs that can be performed while the Owner has occupied the building and without undue annoyance to personnel will be acceptable under the definition of Substantial Completion. It shall also include major final cleaning required under the

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Contract, removal of all surplus equipment and material not required for completion of remaining work, and the placement of remaining materials and equipment in convenient locations as approved by the Owner.

Superintendent: The representative of the Contractor, authorized by the Contractor to receive and fulfill instructions from the Designer.

Supplemental Agreement: A supplemental agreement is any agreement entered into between the Contractor and the Owner with the approval of the Bureau and the Designer subsequent to the execution of the contract.

Surety: The individual, partnership, or corporation who is bound jointly and severally with the Contractor and sub-Contractor to insure his faithful performance of the contract and for his payment of the bills for labor, materials and equipment by the Contractor and Sub-Contractors.

Work: See Project.

**ARTICLE 2. INTENT, CORRELATION AND EXECUTION OF DOCUMENTS**

The intent of the Contract Documents is to prescribe a complete work or improvement. The Plans, including all revisions, General Conditions for Contract Work, Special Provisions, Instructions to Bidders, Proposal, Contract, Contract Bonds, and all other sections of the specifications, including all addenda, all dated and on file in the Bureau of General Services, prior to the time set for receiving proposals as prepared by the Designer, shall each become a part of the Contract Documents, and all proposals must be based on a full compliance therewith. Any Supplemental Agreements entered into subsequent to the Contract will become a part of said Contract.

The contract documents are complementary, and what is called for by any one shall be as binding as if called for by all. The intention of the documents is that, unless otherwise specified, the Contractor shall furnish all labor, materials, equipment, items, articles, tools, transportation, insurance, services, necessary supplies, operations or methods and incidentals that may be reasonably required to construct and complete the project, facility or improvement in a manner necessary for the proper execution of the work. Any deviations from the plans which may be required by the exigencies of the construction, or because of error, will in all cases, be determined by the Designer, and authorized in writing subject to approval by the Owner and Bureau of General Services. Materials or work described in words, which so applied, have a well-known technical or trade meaning shall be held to refer to such recognized standards. Since the plans and specifications cover the dimensions and features of the work and do not set forth the analysis of the design, it is the duty of the Contractor fulfilling them to ascertain the true intent in any case where it is doubtful.



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Work not covered under any heading, section, branch, class or trade of the specifications, shall not be supplied unless it is shown on the drawings or is reasonably inferable there from as being necessary to produce the intended results.

The Contractor shall take no advantage of any apparent error or omission in the plans and specifications, and the Designer shall be permitted to make such corrections and interpretations as may be deemed necessary for the fulfillment of the intent of the plans and specifications. Where errors or omissions appear in the contract documents, the Contractor shall promptly notify the Designer in writing of such errors or omissions. Inconsistencies in the contract documents are to be reported before proposals are received, whenever found.

Should the Drawings or the Specifications disagree in themselves or with each other, the Contractor shall provide the better quality or greater quantity of work and/or materials unless otherwise directed by written addendum to the Contract Documents.

The Contractor shall, upon his acceptance of a contract and before commencing work, contact the Designer and request a preconstruction conference. The purpose of this conference shall be as follows:

1. To introduce the members of the Designer's firm and the representative of the Owner and define their responsibilities in connection with this project.
2. To emphasize any special provisions applicable to the project.
3. To establish the work progress schedule and set up procedures for prompt review of all required shop drawings. If the Contract Sum exceeds \$ 10,000,000. the Contractor shall supply the Owner with the planned Critical Path Method ("CPM") schedule prior to the submission of the first payment requisition. The Contractor shall supply the Owner monthly with CPM "as built" schedule updates. The update shall include the dates of activities' start and completion; percent of work remaining for activities started but not completed; narrative report indicating a listing of monthly progress; any changes to critical path activities from the prior update; sources of delay and potential problems; and work planned for the next month. If any date is more than fifteen (15) days behind, the Contractor must submit a recovery schedule. When a Change Order is proposed, the Contractor must identify all schedule impacts which result from the Change Order.
4. To provide the Contractor with opportunity to discuss points of doubt and any apparent inconsistencies noted in the plans and specifications before proceeding to purchase material or execute the work.

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During the further progress of work, regular meetings will be held at time intervals appropriate in the judgment of the Designer to review the work progress schedule, general project progress and any other questions, which might affect the execution of this contract.

**ARTICLE 3: DETAIL DRAWINGS AND INSTRUCTIONS**

The Designer shall furnish, with reasonable promptness, additional instructions by means of drawings or otherwise, that are necessary for the proper execution of the work. All such drawings and instruction shall be consistent with the contract documents, shall be true developments thereof, and shall be reasonably inferable there from.

The work shall be executed in conformity therewith and the Contractor shall do no work without proper drawings and instructions except as allowed by Article 13.

Immediately after being awarded the contract, the Contractor shall prepare an estimated progress schedule and submit same for Designer's approval. It shall indicate the dates for starting and completion of the various stages of construction.

**ARTICLE 4: COPIES FURNISHED**

Unless otherwise provided in the contract documents the Contractor will be furnished, free of charge, 10 copies of all drawings, and specifications.

**ARTICLE 5: SHOP DRAWINGS**

The Contractor shall check and verify all field measurements and shall submit with such promptness as to cause no delay in the Contractor's own work or in that of any other Contractor, adequate copies, checked and approved by the Contractors of all shop drawings and schedules required for the work of the various trades. The Designer shall check and approve, with reasonable promptness, such scheduled drawings only for conformance with the design concept of the project and compliance with the information given in the contract documents. The Contractor shall make any corrections required by the Designer, and shall file with the Designer two corrected copies, and shall furnish such other copies as may be needed. The Designers approval of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless the Contractors have, in writing, called the Designer's attention to such deviations at the time of submission and secured the Designer's written approval; nor shall it relieve the Contractors from responsibility for errors in shop drawings or schedules.

**ARTICLE 6: DRAWINGS AND SPECIFICATIONS**

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The Contractor shall keep, in good order, one copy of all drawings and specifications on the work, which will be made available to the Designer and to his representative.

**ARTICLE 7: OWNERSHIP OF DRAWINGS**

All drawings, specifications and copies thereof furnished by the Designer are the property of the Designer. They are not to be used on other work without written permission from the Designer, and, with the exception of the signed contract set, are to be returned to the Designer upon request, or at the completion of the work.

**ARTICLE 8: SAMPLES**

The Contractor shall furnish for review, with reasonable promptness, all samples as directed by the Designer. The Designer shall check and review such samples, with reasonable promptness, only for conformance with the design concept of the project and for compliance with the project and for compliance with the information given in the contract documents. The work shall be in accordance with reviewed samples.

**ARTICLE 9: MATERIALS, APPLIANCE, EMPLOYEES**

Unless otherwise stipulated, the Contractor shall provide and pay for all materials, labor, water, tools, equipment, light, power, transportation and facilities necessary for the execution and completion of the work.

Whenever an article or material is defined by describing a proprietary product, or by using the name of a manufacturer, the term "Or Approved Equal", if not inserted, shall be implied. The specific article or material mentioned shall be understood to establish minimum standards as to the type, function, standard of design, durability, efficiency and quality desired and shall not be construed to exclude other manufacturers' products of comparable quality, design and efficiency.

Materials and models of items, which the Contractor alleges to be equal to the materials and methods of items named in the specifications, shall be subject to the written approval by the Designer. If the alleged equals are to receive consideration in the bid award, written approval shall be received from the Designer at least ten days prior to the established bid opening dates. The use of alternate items will not be permitted without the approval of the Owner and Designer. All approved substitutions shall be in writing and approved by the Designer. The Contractor shall not be relieved of the responsibility to furnish articles or materials equal in quality, design and efficiency to those specified because of the approval of such alternate items by the Designer. The Designer's approval or rejection of a proposed substitution may be based on any of the previous considerations, and his decision may or may not express reasons for rejection and shall

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be final. Requests for substitutions shall originate and be submitted by the Contractor, not a Sub-Contractor. The materials or equipment shall be sufficiently described to enable the Designer to easily identify salient features.

Any material or products not specified in the bidding documents but being worthy of consideration may be introduced by the Contractor, or Sub-Contractor. The Contractor's submission shall include a cost comparison with the specified material and the reason for the suggested substitution. The basic proposal shall be as specified.

It shall be understood by the general Contractor or Sub-Contractor that the attached letter describing the proposed changes will not be used in determining the low general Contractor or Sub-Contractor proposal submitted, unless the general Contractor or Sub-Contractor has submitted its list to the Designer 10 days prior to the date set for the receipt of their respective proposals and has received written approval by the Designer five days prior to the opening of the bid.

The Contractor shall guarantee his work against any defects in workmanship and materials for a period of one year from the date of the written acceptance of the project.

Materials and equipment shall be new, free from defects, perfect and complete, unless otherwise stipulated. Materials or equipment specified or shown on the drawings shall be applied or installed according to the directions with the manufacturer, or the recommendations of an association dealing primarily with the material, unless specifically designated otherwise. The scope of the direction furnished shall include the application of experienced personnel to each trade involved. In no case shall the installation be below the standard recommended by the manufacturer or association.

The Contractor shall be responsible to the Owner for the suitability of materials and equipment furnished and for full compliance with the specification.

The Contractor shall promptly pay all his employees when their pay is due, shall promptly pay when due all bills for materials, supplies and services going into the work, and all bills for insurance, workmen's compensation coverage, federal and state unemployment compensation, and Social Security charges applicable to said project. Before final settlement is made, the Contractor shall furnish to the Owner affidavits that all said payments have been made.

The Contractor shall at all times enforce strict discipline and good order among his employees, and shall not employ on the work any unfit person or anyone not skilled in the work assigned to him.

**ARTICLE 10: ROYALTIES AND PATENTS**

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The Contractor shall, for all time, secure to the Owner the free and undisputed right to the use of any and all patented articles or methods used in the work and shall defend at his own expense any and all suits for infringement or alleged infringement of such patents, and in the event of adverse award under patent suits, the Contractor shall pay such awards and hold the Owner harmless in connection with any patent suits that may arise as a result of installations made by the Contractor, or to any awards made thereunder.

**ARTICLE 11: SURVEYS, PERMITS, LAWS, TAXES AND REGULATIONS**

The Owner shall furnish all surveys unless otherwise specified.

Permits and licenses necessary for the prosecution of the work shall be secured and paid for by the Contractor. Easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the Owner, unless otherwise specified.

The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the drawings and specifications are at variance therewith, the Contractor shall promptly notify the Designer in writing and any necessary changes shall be adjusted as provided in the contract for changes in the work. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations and without such notice to the Designer, the Contractor shall bear all costs arising there from.

Adherence to the Code of Federal Regulations 29 CFR Part 1926 and 29 CFR Part 1910 as adopted by the State Board of Occupational Safety and Health is required by statute.

The State is exempt from the payment of Federal Excise Taxes on articles not for resale and for the Federal Transportation Tax on all shipments. All quotes from the Contractor and Sub-Contractors shall be free of these taxes. The State is exempt from the payment of Maine State Sales and Use Taxes. All quotes from the Contractor and Sub-Contractors shall be free of these taxes.

In execution and performance of the Contract, the Contractor and all subcontractors agree to be aware of and to comply with the requirements and regulations of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et. seq.)

**ARTICLE 12: LABOR AND WAGES**

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All Contractors and Sub-Contractors shall conform to the labor laws of the State of Maine, and all other laws, ordinances and legal requirements affecting the Work in Maine.

In the employment of laborers, preference shall first be given to residents of the State of Maine who are qualified to perform the work to which the employment relates, and if they cannot be obtained in sufficient numbers, then to citizens of the United States, who may reside in other states.

**ARTICLE 13: CONDITIONS AND CARE OF SITE AND PROTECTION OF THE WORK**

The Contractor shall continuously maintain adequate protection of all work from damage and shall protect the property from injury or loss for the duration of this contract, and shall make good any such damage, injury or loss. He shall adequately protect adjacent property as provided by law and the contract documents.

The Contractor shall take all necessary precautions for the safety of employees on the work, and shall comply with all applicable provisions of federal, state and municipal safety laws and building codes, and shall prevent accidents or injury to persons on, about or adjacent to the premises where the work is being performed. The Contractor shall erect and properly maintain all necessary safeguards for the protection of workmen and the public at all times, as required by the condition and progress of the work, and shall post danger signs warning against all hazards created by the construction process, such as (but not limited to) protruding nails, hoists, well holes, elevator hatchways, scaffolding, window openings, stairways and falling materials. The Contractor shall designate a responsible member of his organization on the work, whose duty shall be the prevention of accidents. The Contractor shall report the name and position of any person so designated to the Designer.

The Contractor shall return to conditions existing prior to the start of work on the project, all aspects of the site that have not been altered, removed, or otherwise changed permanently by the work. The Contractor shall protect all existing buildings, structures, or other features from damage by any operation in connection with the project. Utilities encountered shall be protected and maintained in service until removed or abandoned. The Contractor shall exercise care in his work around such utilities as may be shown on the plot plan or otherwise found. Such utilities are not to be moved, replaced or abandoned.

The Contractor shall protect existing trees, and other aspects of the site, which will remain a permanent part of the site from damage during grading, excavation, filling, trucking, etc. If necessary, tree trunks shall be boxed, and barricades set up at sufficient distance to prevent damage to major tree branches.

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Should the work or material of this or any other Contractor employed by the Owner become damaged when reasonably protected, the same shall be replaced by the Contractor causing the damage at no expense to the Owner.

In an emergency potentially affecting health or life or of serious damage to property or of adjoining property, the Contractor, without special instruction or authorization from the Designer or Owner, is hereby permitted to act on his own discretion, to prevent such threatened loss or injury, and the Contractor shall so act, without appeal, if so authorized or instructed. Any compensation claimed by the Contractor on account of emergency work, shall be determined by agreement.

**ARTICLE 14: INSPECTION OF WORK**

The Designer and his representatives, the Bureau of General Services representatives and the Owner, shall at all times have access to the work whenever it is in preparation or progress. The Contractor shall provide proper facilities for such access and for inspection.

If the specifications, the Designer's instructions, laws, ordinances or any public authority require any work to be specially tested or approved, the Contractor shall give the Designer timely notice of its readiness for observation by the Designer or inspection by another authority, and if the inspection is by another authority than the Designer, on the date fixed for such inspection, required certificates of inspection shall be secured by the Contractor. Observations by the Designer shall be promptly made, and where practicable, prior to work is covered or buried. If any work which will ultimately be covered, is covered prior to approval or consent of the Designer, it must, if requested by the Designer, be uncovered for examination at the Contractor's expense.

Reexamination of questioned work may be ordered by the Designer, and, if so ordered, the work must be uncovered by the Contractor. If such work were found in accordance with the contract documents, the Owner shall pay the cost of the reexamination and replacement. If such work were found not in accordance with the contract documents, the Contractor shall pay such cost, unless it is found that the defect in the work was caused by a Contractor employed as provided in Article 32, and in that event the Owner shall pay such cost.

The Bureau of General Services, through its representatives shall make periodic inspections of the work during the course of construction and make recommendations to the Designer, when employed. The Designer shall provide adequate inspection of materials, equipment, methods and changes in plans on all projects under his supervision.

**ARTICLE 15: SUPERINTENDENCE: SUPERVISION**

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The Contractor shall have, during the progress of all work, a competent superintendent and any necessary assistants. The superintendent shall not be changed except with the consent of the Owner unless a superintendent proves to be unsatisfactory to the Contractor and ceases to be in his employ. The superintendent shall represent the Contractor and all directions given to the superintendent in the absence of the Contractor shall be as binding as if given directly to the Contractor. Important directions shall be confirmed in writing to the Contractor. Other directions shall be confirmed on written request in each case. The Designer shall not be responsible for the acts or omissions of the superintendent or his assistants.

The Contractor shall give efficient supervision to the work using his best skill and attention. He shall carefully study and compare all drawings, specifications and other instructions and shall at once report to the Designer any error, inconsistency or omission which he may discover, but he shall not be liable to the Owner for any damage resulting from any errors or deficiencies in the contract documents or other instructions by the Designer.

**ARTICLE 16: CHANGES IN THE WORK**

The Owner reserves the right to increase or decrease any or all of the items of work indicated in the plans, proposal, and contract, or the elimination of any one or more of such items, without invalidating the contract. As the work progresses, the Owner may make such alterations in the plans, in the character of the work, or in the specified coordination of two or more concurrent contracts, as may be considered necessary or desirable in order to complete the construction. Such changes shall in no way invalidate the contract. All such work shall be executed under the conditions of the original contract except that any claim for extension of the time caused thereby shall be adjusted at the time of the ordering of such change.

In giving instructions, the Designer shall have authority to make minor changes in the work, not involving extra cost, and not inconsistent with the purposes of the building or project, but otherwise, except in an emergency endangering life or property, no extra work or change shall be made unless in pursuance of a duly signed change order.

Should the Contractor encounter during the progress of the work, latent conditions at the site materially differing from those shown on the drawings or in the specifications, or unknown conditions of an unusual nature differing materially from those already encountered in such work, the attention of the Designer shall be immediately called for such conditions before they are disturbed. The Designer shall promptly investigate the conditions and if they do so materially differ, the contract shall, with the approval of the Owner and the Bureau be modified by a change order to provide for any increase or decrease in cost resulting from such conditions.



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Should such alterations be productive of increased unit cost, or result in decreased unit cost to the Contractor, a fair and equitable sum therefore shall be agreed upon in writing before such work is begun, and shall be added to or deducted from the contract amount, as the case may be, by means of a written change order. The change order shall state the nature of the change, the location, the itemized estimate of unit quantities, the basis for payment, and the reason for the change. Such change order to be on approved forms.

When the change order has been properly signed by all parties and encumbered, it shall become a part of the contract.

The value of any such extra work or change shall be determined in one or more of the following ways:

- A. By estimate and acceptance in a lump sum.
- B. By unit prices named in the contract or subsequently agreed upon.
- C. By cost and percentage or by cost and a fixed fee.

If none of the above methods is agreed upon, the Contractor, provided he receives an order as above, shall proceed with the work.

Under case (C.), he shall keep and present in such form as the Designer may direct, a correct account of the cost, together with vouchers. In any case, the Designer shall certify to the amount, including reasonable allowance for overhead and profit, due to the Contractor. Pending final determination of value, payments on account of changes shall be made on the Designer's certificate.

If the price of a change order cannot be agreed upon, nothing contained herein shall prevent the Designer, with approval from the Owner and BGS, from directing the Contractor to make a change in the work, with the price to be determined on either a cost and percentage basis or under the dispute resolution provision of this contract.

If the price of a change order cannot be agreed upon, an Owner and/or Designer initiated Construction Change Directive can order a change in the work prior to an agreement on the adjusted Contract Sum or Contract Time. The Cost of the work is to be determined by: 1) a cost and percentage basis 2) lump sum 3) unit prices or 4) under the Dispute Resolution provision of this contract.

When the subparagraphs (A) and (C) above are used to determine the value of the work, the allowance for overhead and profit combined, included in the total expense to the Owner, shall be based upon the following schedule:

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For the Contractor, for any work performed by his own forces, 20% of the cost;  
For each Sub-Contractor, for work performed by his own forces, 20% of the cost;  
For the Contractor, for work performed by his Sub-Contractor, 10% of the  
amount  
due the Sub-Contractor.

Cost shall be limited to the following: Cost of materials, cost of delivery, cost of labor, including Social Security, old age and unemployment insurance (labor cost may include a pro ratio share of foremen's time, only in case an extension of contract time is granted on account of the change); workmen's compensation insurance; rental value of power tools and equipment.

Overhead shall include the following; bond premium, supervision, wages of timekeepers, watchmen and clerks, small tools, incidental, general office expense, and all other expenses not included in "cost".

If the net value of a change results in a credit from the Contractor or Sub-Contractor the credit given shall be the net cost without overhead or profit. The cost as used herein shall include all items of labor, materials and equipment.

**ARTICLE 17: CLAIMS FOR EXTRA COST**

If the Contractor claims that any instructions by drawings or otherwise involve extra cost under this contract, he shall give the Designer written notice thereof within 10 days after the receipt of such instructions, and in any event before proceeding to execute the work, except in emergency endangering life or property, and the procedure shall then be as provided for in Section 16, "changes in work." No such claim shall be valid unless so made.

**ARTICLE 18: DEDUCTIONS FOR UNCORRECTED WORK**

If the Designer and Owner deem it inexpedient to correct work injured or done not in accordance with the contract, an equitable deduction from the contract amount shall be made therefore.

**ARTICLE 19: DELAYS AND EXTENSION OF TIME**

If the Contractor is delayed at any time in the progress of the work by any act or neglect of the Owner or the Designer, or of any employee of either, or by any separate Contractor employed by the Owner, or by changes ordered in the work or by strikes, lockouts, fire, unusual delay in transportation, unavoidable casualties Or by causes beyond the Contractor's control, or by any cause which the Designer shall decide to justify the delay, then the time of completion shall be extended for such reasonable time

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as the Designer may decide. Inclement weather or other natural causes shall not be reason to allow additional time under this contract.

No such extension shall be made for delay occurring more than seven days before claim therefore is made in writing to the Designer. In case of a continuing cause of delay, only one claim is necessary.

If no schedule or agreement stating the dates upon which drawings shall be furnished is made, then no claim for delay shall be allowed on account of failure to furnish drawings until two weeks after demand for such drawings and not then unless such claim be reasonable.

This article does not exclude the recovery of damages for delay by either party under other provisions in the contract document. The amount of Contractor's delay damages shall be limited to the Costs, overhead and profit items enumerated in Article 16. Recovery of delay damages is conditioned upon compliance with the notice requirements of Article 17.

**ARTICLE 20: CORRECTION OF WORK**

The Contractor shall promptly remove from the premises all work condemned by the Designer as failing to conform to the contract, whether incorporated or not, and the Contractor shall promptly replace and re-execute his own work in accordance with the contract and without expense to the Owner and shall bear the expense of making good all work of other Contractors destroyed or damaged by such removal or replacement.

If the Contractor does not remove such condemned work within a reasonable time, fixed by written notice, the Owner may remove it and may store the material at the expense of the Contractor. If the Contractor does not pay the expenses of such removal within ten days time, thereafter, the Owner may, upon ten days written notice, sell such materials at auction or at private sale and shall account for the net proceeds thereof, after deducting all the costs and expenses that should have been borne by the Contractor.

The Contractor shall remedy any defects due to faulty materials or workmanship and pay for any damage to other work resulting therefrom, which shall appear within a period of one year from the date of final payment, or from the date of the Owner's substantial usage or occupancy of the project, whichever is earlier, and in accordance with the terms of any special guarantees provided in the contract. The Owner shall give notice of observed defects with reasonable promptness. All questions arising under this article will be decided by the Designer, notwithstanding final payment.

**ARTICLE 21: OWNER'S RIGHT TO DO WORK**

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If the Contractor should neglect to prosecute the work properly or fail to perform any provisions of this contract, the Owner, after three days written notice to the Contractor may, without prejudice to any other remedy may make good such deficiencies and may deduct the cost thereof from the payment; then or thereafter due the Contractor, provided, however, that the Designer shall approve both such action and the amount charged to the Contractor.

**ARTICLE 22: OWNER'S RIGHT TO TERMINATE CONTRACT**

If the Contractor should be adjudged bankrupt, or if the Contractor should make a general assignment for the benefit of its creditors, or if a receiver should be appointed on account of the Contractor's insolvency, or if the Contractor should persistently or repeatedly refuse or should fail, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials or if the Contractor should fail to make prompt payment to Sub-Contractors or for material, or labor, or persistently disregard laws, ordinance or the instructions of the Designer, or otherwise be guilty of a substantial violation of any provision of the contract, then the Owner, upon the certificate of the Designer that sufficient cause exists to justify such action, may without prejudice to any other right or remedy and after giving the Contractor and the Contractor's surety seven days written notice, terminate the employment of the Contractor and take possession of the premises and of all materials, tools and appliances thereon and finish the work by whatever method the Owner may deem expedient. In such case the Contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the contract amount shall exceed the expense of finishing the work including compensation for additional Designer, managerial and administrative services, such excess shall be paid to the Contractor. If such expense shall exceed such unpaid balance, the Contractor shall pay the difference to the Owner. The expense incurred through the Contractor's default, shall be certified by the Designer.

**ARTICLE 23: THE CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE CONTRACT**

If the work should be stopped under an order of any court, or other public authority, for a period of thirty days, through no act or fault of the Contractor or of anyone employed by him, then the Contractor, may, upon seven days written notice to the Owner and the Designer, terminate this contract and recover from the Owner, payment for all work executed and any proven loss sustained upon any plant or materials and reasonable profit and damage.

Should the Designer fail to issue any certificate for payment, through no fault of the Contractor, within seven days after the Contractor's formal request for payment or if the Owner should fail to pay to the Contractor within 30 days after presentation, any sum certified by the Designer, then the Contractor may, upon seven days' written notice to the

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Owner and the Designer, stop the work or terminate this Contractor as set out in the preceding paragraph.

**ARTICLE 24: PAYMENTS**

The Contractor shall, before the first application for payment, submit to the Designer in triplicate a "contract cost breakdown" form acceptable to the Designer, if required, this form shall be supported by such evidence as to its correctness as the Designer may direct and, shall be reviewed by the Designer and unless found to be in error, used as a basis for payments.

The Contractor shall submit to the Designer an application for each payment on the latest revision of the BGS "Requisition for payment" form, and, if required, receipts or other vouchers, showing his payments of materials and labor, including payments to sub-Contractors as required by Article 34.

Application for payment as the Work progresses may be made of the Owner but no more often than once a month, unless due to unusual circumstance the Owner may approve more frequent payment. Said requisition for payments shall be based on the proportionate quantities of the various classes of work completed or incorporated in the Work, in accordance with the Work progress schedule and the value thereof determined from the contract cost breakdown. Payments, upon authorization of the Designer, may be made on account of materials not incorporated in the Work but delivered and suitably stored at the site. Such payments shall be conditioned upon submission by the Contractor of bills of sale, or such other procedure as will adequately protect the Owner's interest including applicable insurance.

In the event any materials are delivered but not yet incorporated in the Work, have been included in any said "Requisition for Payment" and payment thereon made and said materials thereafter deteriorate, become damaged or destroyed or for any reason whatsoever become unsuitable or unavailable for use in the Work, then the full amount allowed therefore in any previous "Requisition for Payment", shall be deducted from the gross value of any subsequent payment or final payment unless the Contractor shall satisfactorily replace said material.

After said "Requisition for Payment" has been prepared by the Contractor in the required number of copies, it shall be submitted to the Designer for review. The Designer shall verify and approve the "Requisition for Payment", and forward all copies to the Owner for processing for payment by the Owner.

No certificate issued nor payment made to the Contractor, nor partial or entire use or occupancy of the Work by the Owner, shall be an acceptance of any Work or materials not in accordance with this contract. Except for those claims previously made by either party and still unsettled, the making and acceptance of the final payment shall constitute

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a waiver of all claims by the Owner, other than those arising from unsettled liens, those not complying with the requirements of the plans and specifications, those covered by warranties, and of all claims by the Contractor.

Title 5 M.R.S.A. Section 1746 as amended provides that in any contract awarded for any public improvement, the State shall withhold 5% of the money due the Contractor until the project under the contract has been accepted by or for the State, except that when the contract has been *substantially completed* the State may, upon request, further reduce the amounts withheld if it deems it desirable and prudent, or except when the Contractor elects to deposit with the Treasurer of the State certain Government Bonds as provided in Chapter 437, Public Laws of 1967.

With each monthly requisition the Contractor shall release and indemnify the owner from and against all liens on the project through the requisition date and shall supply partial lien waivers from all subcontractors through the date of the prior requisition.

All payments to be made in accordance with Title 10 MRSA Chapter 201-A “An Act to Ensure Prompt and Equitable Payment for Construction Services”.

**ARTICLE 25. PAYMENTS WITHHELD**

The Designer may withhold or, on account of subsequently discovered evidence, nullify the whole or a part of any certificate to such extent as may be necessary in his reasonable opinion to protect the Owner from loss on account of:

- A. Defective work not remedied.
- B. Claims filed or reasonable evidence indicating probable filing of claims.
- C. Failure of the Contractor to make payments properly to Sub-Contractors for materials or labor.
- D. A reasonable doubt that the contract can be completed for the balance then unpaid.
- E. Damage to another Contractor.
- F. Damage to the premises or Work.
- G. Failure to carry out the Work in accordance with the Contract Documents.

When the above grounds are removed, payments shall be made for amounts withheld because of them.

**ARTICLE 26. CONTRACTOR'S INSURANCE REQUIREMENTS**

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The Contractor shall not commence work under this contract until the Contractor has obtained all insurance required under this article and such insurance has been approved by the Owner, nor shall the Contractor allow any Sub-Contractor to commence work on a subcontract until all similar insurance required of the Sub-Contractor has been so obtained and approved.

The State and the Owner does not warrant or represent that the insurance required under this paragraph constitutes an insurance portfolio which adequately addresses all risks faced by the Contractor or its Sub-Contractors. The Contractor and Sub-Contractors of every tier shall satisfy themselves as to the existence, extent and adequacy of insurance prior to commencement of work.

The Contractor and any Sub-Contractor shall procure and maintain for the duration of the Project insurance of the types and limits set forth under this paragraph and such insurance as will protect themselves from claims which may arise out of or result from the Contractor's or Sub-Contractor's execution of the work, whether such execution be by themselves or by anyone directly or indirectly employed by any of them or by anyone for whose acts any of them may be liable. The insurance coverage provided by the Contractor and any Sub-Contractor will be primary coverage. All required insurance coverages shall be placed with carriers authorized to conduct business in the State of Maine by the Maine Bureau of Insurance.

A. Workers' Compensation Insurance

Worker's compensation insurance for all employees on site in accordance with the statutory workers' compensation law of the State of Maine.

Minimum acceptable limits for Employer's Liability are:

Bodily Injury By Accident	\$500,000
Bodily Injury by Disease	\$500,000 Each Employee
Bodily Injury by Disease	\$500,000 Policy Limit.

B. Liability Insurance

1. General Liability Insurance

General liability insurance shall be on a form providing coverage not less than that of the 1996 occurrence version of the Insurance Services Office (ISO) Commercial General Liability Policy. This insurance shall cover bodily injury and property damage liability for all hazards of the Project including premise and operations, products and completed operations, contractual, and personal injury liabilities. It shall include collapse and underground coverage - as well as explosion coverage if explosion hazards exist. Aggregate limits shall apply on a per location or project basis.

Minimum acceptable limits are:

General aggregate limit:	\$2,000,000
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Products and completed operations aggregate:	\$1,000,000
Each occurrence limit:	\$1,000,000
Personal injury aggregate:	\$1,000,000

2. Automobile Liability Insurance

Automobile liability insurance against claims for bodily injury, death or property damage resulting from the maintenance, Ownership or use of all owned, nonowned and hired automobiles, trucks and trailers.

Minimum acceptable limit is \$1,000,000 any one accident or loss.

3. Owners Protective Liability

For Contracts exceeding \$50,000 in total Contract amount, Contractor shall secure an Owners Protective Liability policy naming the Owner as the Named Insured.

Minimum acceptable limits are:

General aggregate limit:	\$2,000,000
Each occurrence limit:	\$1,000,000

4. Pollution Liability

In the event that any disruption, handling, abatement, remediation, encapsulation, removal, transport, or disposal of contaminated or hazardous material is required, the Contractor or its Sub-Contractor shall secure a pollution liability policy in addition to any other coverages contained in this section. The insurance shall be provided on an occurrence based policy and shall remain in effect for the duration of the Project.

Minimum acceptable limit is \$1,000,000 per occurrence.

C. Property Insurance

Unless otherwise waived in writing by the Owner, the Contractor shall procure and maintain Builder's Risk insurance naming the Owner, Contractor and any Sub-Contractor as insureds as their interest may appear. Covered causes of loss form shall be all Risks of Direct Physical Loss, endorsed to include flood, earthquake, transit and sprinkler leakage where sprinkler coverage is applicable. Unless specifically authorized in writing by the Owner, the limit of insurance shall not be less than the initial contract amount and coverage shall apply during the entire contract period and until the work is accepted by the Owner.

D. Certificates of Insurance

Four original copies of all certificates of insurance in a form and issued by companies acceptable to the Owner shall be provided to the Designer prior to commencement of work. The certificates shall name the Owner as certificate holder and shall contain a provision that coverage afforded under the insurance policies will not be canceled or



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materially changed unless at least thirty (30) days prior written notice by registered letter has been given to the Owner.

**ARTICLE 27: CONTRACT BONDS**

The Contractor shall furnish to the Owner and State upon execution of the contract, a contract performance bond and a contract payment bond; each for the full amount of the contract and issued by a surety company or surety companies authorized to do business in the State of Maine as approved by the Owner and State. The bonds shall be in accordance with and executed on the forms furnished in the specifications. The bonds shall allow for any addition or deductions to the contract.

The contract bonds shall continue in effect for the applicable periods limiting actions as provided by, as applicable, 14 MRSA Section 871 or Section 752 to protect the Owner's interest and to assure settlement of claims for the payment of all bills for labor, materials, and equipment by the Contractor.

The Contractor shall submit to the Bureau of General Services through the Designer, copies of the Contract Performance Bond and Contract Payment Bond for each of the Filed Sub-Bid Subcontractors that were required to submit Bid Bonds.

**ARTICLE 28: DAMAGES**

1. The Contractor shall indemnify and hold harmless the Owner and the Designer and their agents and employees from and against all claims, damages, losses, and expenses including attorneys' fees arising out of or resulting from the performance of the work, provided that any such claim, damage, loss, or expense (a) is attributable to bodily injury sickness, disease or death, or injury to or destruction to tangible property (other than the work itself) including the loss of use resulting therefrom, and (b) is caused in whole or in part by a negligent act or omission of the Contractor, any Sub-Contractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder.
2. In any and all claims against the Owner or the Designer or any of their agents or employees, by any employee of the Contractor, any Sub-Contractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 1 shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for the Contractor or any Sub-Contractor under Workmen's Compensation Acts, disability benefit acts, or other employee benefit acts.

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3. The obligations of the Contractor under paragraph 1 shall not exceed the liability of the Designer, the Designer's agents or employees arising out of:

(a) The preparation or approval of maps, drawings, opinions, reports, surveys, change orders, designs or specifications; or

(b) The giving of or the failure to give directions or instructions by the Designer, the Contractor, agents or employees provided such giving or failure to give is the primary cause of the injury or damage.

**ARTICLE 29: LIENS**

Neither the final payment nor any part of the retained percentage shall become due until the Contractor, shall deliver to the Owner a complete release of all liens arising out of this contract, or receipts in full in lieu thereof, and, an affidavit that so far as the Contractor has knowledge or information the releases and receipts include all the labor and material for which a lien could be filed; but the Contractor, may if any Sub-Contractor refuses to furnish a release or receipt in full, furnish a bond satisfactory to the Owner, to indemnify him against any lien. If any lien remains unsatisfied after all the payments are made, the Contractor shall refund to the Owner all moneys that the latter may be compelled to pay in discharging such lien, including all cost and reasonable attorney's fee.

**ARTICLE 30: ASSIGNMENT**

Neither party to the contract shall assign the Contractor or sublet it as a whole without the written consent of the other, nor shall the Contractor assign any money due or to become due to him hereunder, without the previous written consent of the Owner.

**ARTICLE 31: MUTUAL RESPONSIBILITY OF CONTRACTORS**

Should the Contractor cause damage to any separate Contractor on the work, the Contractor agrees, upon due notice, to settle with such Contractor by agreement or arbitration, if he will so settle. If such separate Contractor sues the Owner or Designer on account of any damage alleged to have been so sustained, the Owner or Designer shall notify the Contractor, who shall defend such proceedings at the Contractor's expense and if any judgment against the Owner or Designer arises therefrom, the Contractor shall pay or satisfy it and pay all costs incurred by the Owner or Designer.

**ARTICLE 32: SEPARATE CONTRACTS**

The Owner reserves the right to let other contracts in connection with this work under similar general conditions. The Contractor shall afford other Contractors

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reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and coordinate his work with theirs.

If any part of the Contractor's work depends on proper execution or results upon the work of any other Contractor, the Contractor shall inspect and promptly report to the Designer any defects in such work that render it unsuitable for such proper execution and results. The Contractor's failure so to inspect and report shall constitute an acceptance of the other Contractor's work as fit and proper for the reception of his work, except as to defects which may develop in Contractor's work after the execution of the Contractor's work.

To insure the proper execution of the Contractor's subsequent work the Contractor shall measure work already in place and shall at once report to the Designer any discrepancy between the executed work and the drawings.

**ARTICLE 33: SUBCONTRACTS**

The Contractor shall not sublet any part of this contract without the written permission of the Owner.

The Contractor shall submit in writing to the Designer for approval a complete list of the names of all particular items of work he proposes to furnish and the names of the Sub-Contractors to whom the Contractor proposes to sublet work. The Sub-Contractors named shall be reputable firms of recognized standings with a record of satisfactory work. The Contractor shall not employ any Sub-Contractor or use any material that requires approval by any Specification Section until they have been approved, or where there is reason to believe the work will not be accomplished in accordance with the contract documents. The complete list of Sub-Contractors and materials must be submitted for approval to the Designer and Owner.

The Designer shall, on request, furnish to any Sub-Contractor, wherever practicable, evidence of the amounts certified on his account.

The Contractor agrees that he is as fully responsible to the Owner for the acts and omissions of his Sub-Contractor and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

Nothing contained in the contract documents shall create any contractual relation between any Sub-Contractor and the Owner.

**ARTICLE 34: RELATIONS OF CONTRACTOR AND SUB-CONTRACTOR**

The Contractor agrees to bind every Sub-Contractor and every Sub-Contractor agrees to be bound by the terms of the contract documents, as far as they are applicable to

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his work, including the following provisions of this article, unless specifically noted to the contrary in a subcontract approved in writing as adequate by the Owner or Designer.

The Sub-Contractor agrees:

A. To be bound to the Contractor by the terms of the contract documents, and to assume toward the Contractor all the obligations and responsibilities that the Contractor, by those documents, assumes toward the Owner.

B. To submit to the Contractor applications for payment in such reasonable time as to enable the Contractor to apply for payment as specified.

C. To make all claims for extras, for extensions of time and for damages for delays or otherwise, to the Contractor in the manner provided in the general conditions for like claims by the Contractor upon the Owner, except that the time for making claims for extra cost is one week.

The Contractor agrees:

D. To be bound to the Sub-Contractor by all the obligations that the Owner assumes to the Contractor under the contract documents, and by all the provisions thereof affirming remedies and redress to the Contractor from the Owner.

E. To pay the Sub-Contractor, upon the payment of certificates, the amount allowed to the Contractor on account of the Sub-Contractor's work to the extent of the Sub-Contractor's interest therein.

F. To pay the Sub-Contractor, upon the payment of certificates, if issued otherwise as in section E above, so that at all times the Sub-Contractor's total payments shall be as large in proportion to the value of the work done by the Sub-Contractor.

G. To pay the Sub-Contractor to such extent as may be provided by the contract Documents or the subcontract, if either of these provide for earlier or larger payments than the above.

H. To pay the Sub-Contractor on demand for subcontract work or materials as far as executed and fixed in place, less the retained percentage, at the time the certificate should issue, even though the Designer fails to issue it for any cause not the fault of the Sub-Contractor.

I. To make no demand for liquidated damages or penalty for delay in any sum in excess of such amount as may be specifically named in the subcontract.

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J. That no claim for services rendered or materials furnished by the Contractor to the Sub-Contractor shall be valid unless written notice thereof is given by the Contractor to the Sub-Contractor during the first ten days of the calendar month following that in which the claim originated.

K. To give the Sub-Contractor an opportunity to present and to submit evidence in any progress conference or disputes involving subcontract work.

L. To pay the Sub-Contractor a just share of any fire insurance money received by him, the Contractor, under Article 26 of the General Conditions.

**ARTICLE 35: DESIGNER'S STATUS**

The Designer shall be the Owner's representative during the construction period and he shall observe the work in progress on behalf of the Owner. He shall have authority to act on behalf of the Owner only to the extent expressly provided in the contract documents or otherwise in writing, which shall be shown to the Contractor. He shall have authority to stop the work whenever such stoppage may be necessary in his reasonable opinion to insure the proper execution of the contract.

The Designer shall be, in the first instance, the interpreter of the conditions of the contract and the judge of its performance. The Designer shall side neither with the Owner nor with the Contractor, but shall use the Designer's powers under the contract to enforce its faithful performance by both.

In case of the termination of the employment of the Designer, the Owner shall appoint a capable and reputable Designer whose status under the contract shall be that of the former Designer.

**ARTICLE 36: CASH ALLOWANCES**

The Contractor shall include the contract sum and all allowances named in the contract documents and shall cause the work so covered to be done by such Contractors and for such sums as the Designer may direct, the contract amount being adjusted in conformity therewith. The Contractor declares that the contract amount includes such sums for expenses and profit on account of cash allowances, as he deems proper. No demand for expenses or profit other than those included in the contract shall be allowed. The Contractor shall not be required to employ for any such work, persons against whom the Contractor has a reasonable objection.

**ARTICLE 37: USES OF PREMISES**

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The Contractor shall confine his apparatus; the storage of materials and the operations of his workmen to limits indicated by law, ordinances, permits or directions of the Designer, and as required by the Contract Documents, and shall not unreasonably encumber the premises with his materials.

The Contractor shall not load or permit any part of the structure to be loaded with a weight which will endanger its safety. The Contractor shall enforce the Designer's instructions regarding signs, advertisements, fires, and smoking.

If any part of the building is completed and ready for occupancy, the Owner may, by written and mutual consent, without prejudice to any of the Owner's rights or the rights of the Contractor enter in and make use of such completed parts of the building. Such use or occupancy shall in no case be construed as an acceptance of any work or materials.

**ARTICLE 38: CUTTING, PATCHING AND DIGGING**

The Contractor shall do all cutting, fitting or patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by work of other Contractors shown upon, or reasonable implied by, the drawings and specifications for the completed structure, and he shall make good after them as the Designer may direct.

Any cost caused by defective or ill-timed work shall be borne by the party responsible therefore. The Contractor shall not endanger any work by cutting, excavating or otherwise, and shall not cut or alter the work of any other Contractor save with the consent of the Designer. Cutting, drilling, or patching work of Contractors other than the general Contractor shall be done only with the permission and instruction of the general Contractor and Designer. Cutting of structural members must be approved by the Designer. All cutting, patching, and digging of other Contractors in or about the building shall be done under the supervision of the general Contractor who shall be responsible to see that the work is neatly done, and in a manner that will not endanger the structure or harm the component parts, and that patching and back filling shall be done to restore the structure and surfaces to its original condition.

**ARTICLE 39: LAYOUT OF WORK**

The Contractor shall be responsible for the correct staking out of the new work on the site, and shall employ a competent engineer/surveyor to locate the building on the site. He shall run the axis lines locating the work, establish correct datum points, and check each line and point on the site to insure their correctness. All such lines and points shall be carefully preserved throughout the construction.

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The Contractor shall lay out all work from dimensions given on plans. The Contractor shall take measurements and verify dimensions of existing or old work, if any, that affect his work or to which his work is to be fitted. The Contractor alone shall be responsible for the correctness of all measurements and shall verify all grades, lines, levels, elevations and dimensions shown on the drawings and report any errors or inconsistencies to the Designer prior to commencing work.

**ARTICLE 40: WORKMANSHIP**

All workmanship, materials or equipment, either at the site or intended for it shall conform with all respects with the requirements of all the contract documents, and shall be strictly first class, workmanlike installation and the best obtainable from the crafts and trades. Incomplete or careless workmanship will not be allowed. In all cases the materials, equipment and work shall be equal to or better than the grade specified and the best of their kind that is obtainable for the purpose for which they are intended. The Designer's decision on the quality of work shall be final.

All labor shall be performed by mechanics skilled in their respective trades. Prior to submitting a proposal, the Contractor shall become familiar with the local labor conditions, skilled and unskilled.

If, in the opinion of the Contractor, any work is indicated on the drawings or specified in such manner as would make it impossible to produce work of the highest quality, or should discrepancies appear between drawings, or drawings and specifications, the Contractor shall refer the same in writing to the Designer for interpretation before proceeding with the work.

If the Contractor fails to make such reference, no excuse will be entertained thereafter for failure to carry out the work in the satisfactory manner.

The Contractor shall guarantee the Contractor's work against any defects in workmanship and materials for a period of one year from the date of the written final acceptance of the project.

**ARTICLE 41: CLEANING UP**

The Contractor shall at all times keep the premises free from accumulation of waste materials or rubbish caused by his employees or work, and at the completion of the work he shall remove all his rubbish from and about the building and all his tools, scaffolding and surplus materials and shall leave his work "Broom Clean" or its equivalent, unless more exactly specified.

In case of failure to comply by the Contractor, the Owner may perform the cleanup and deduct the cost from any monies due the Contractor.

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**ARTICLE 42: DISPUTE RESOLUTION**

If, in the performance of this contract, there arises a dispute between the Contractor and the Owner that cannot be resolved by the parties to the contract, the dispute shall be referred to the Director of the Bureau of General Services who, at his/her discretion, will submit the dispute to non-binding Alternate Dispute Resolution (ADR) or binding arbitration. If the parties in dispute are not satisfied with the results of ADR the Owner or the Contractor may resubmit the dispute to the Director of the Bureau of General Services for binding arbitration.

In any non-binding Alternative Dispute Resolution (ADR) or binding arbitration between the Owner and the Contractor, the Owner may elect to consolidate related claims between the Owner and the Designer. Any mediator and/or arbitrator shall be subject to the mutual approval of the Owner, the Contractor and, as applicable, the Designer, such approval not to be unreasonably withheld by any party.

**ARTICLE 43: COMPLETION TIME AND LIQUIDATED DAMAGES**

a) The Date(s) of Completion is stated in the Proposal Form Section 2-B and in the Contract Form Section 2-E. If the Contractor finds it impossible to complete the Work on or before the said Date(s) of Completion, he make a written request to the Owner for an Extension of Time setting forth therein the reasons for the request. If the Owner finds that the Work was delayed because of conditions beyond the control and without the fault of the Contractor he may extend the Date(s) of Completion which will then be in full force and effect, the same as though it was the original Date(s) of Completion. b) Time is an essential element of the Contract and it is important the Work be pressed vigorously to Completion. The cost to the Owner of Administration of the Contract, inspection and supervision will be increased as the time occupied in the Work, is lengthened. c) For each calendar day that the Work shall remain uncompleted after the Date(s) of Completion specified in the Contract, the amount per day, listed below in the Schedule of Liquidated damages, shall be deducted from any money due the Contractor, not as a penalty but as liquidated damages, provided, however that due account shall be taken of any adjustment of the Date(s) of Completion granted under the provisions of Paragraph (a) above. d) The Contractor shall expressly be prohibited from filing delay claims or attempting to recover damages for its scheduled early completion. The Owner and Designer have not requested accelerated schedules and cannot accommodate the Contractor if he chooses to accelerate the Work. The Owner and Designer have designed the Project to be done in an orderly fashion which allows for bad weather, minor changes in the Work, and an orderly submittal and review process of materials and workmanship. Any Contractor choosing to bid the project with accelerated completions, earlier than those allowed by the phasing plan, has a duty to inform the project owner of the Contractor's intention to achieve early completion and he shall also note early completion as a qualification on his bid form. The Owner reserves the right to reject all bids containing limitations or qualifications.



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SCHEDULE OF LIQUIDATED DAMAGES

<u>Damages</u>	<u>Amount of</u>
<u>Original Contract Amount</u>	<u>Liquidated</u>
	<u>Per Day</u>
More than \$ 100,000 and less than \$ 3,000,000	\$ 750.00
More than \$ 3,000,000 and less than \$ 7,000,000	\$ 1000.00
More than \$ 7,000,000 and less than \$ 10,000,000	\$ 1500.00
More than \$ 10,000,000	\$ 1500.00 plus \$ 150 per \$ 1,000,000

DOCUMENT 000320 - INFORMATION AVAILABLE TO BIDDERS

The following information is provided for informational purposes only. It is not part of the Contract document.

1. A City of Portland and Portland Public Schools Stormwater Management Law is included in the Appendix of this project manual.
2. A Notice of Termination for use with Construction General Permit Form is included in the Appendix of this project manual.
3. A Geotechnical Report was prepared by S.W. Cole Engineering, Inc., for the Owner on this project. A copy is included in the Appendix of this project manual. Boring Logs are including in the drawings sheets.
4. A topographic survey was prepared by Coffin Engineering, Inc. for use by the Owner of this project. A copy is included with the drawing sheets.

END OF DOCUMENT 000320

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## SECTION 011000 - SUMMARY

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Work covered by the Contract Documents.
  - 2. Type of the Contract.
  - 3. Work under separate contracts.
  - 4. Owner-furnished products.
  - 5. Use of premises.
  - 6. Work restrictions.
  - 7. Specification formats and conventions.
- B. Related Sections include the following:
  - 1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

## 1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Ocean Avenue Elementary School.
  - 1. Project Location: Portland, Maine.
- B. Owner: Portland School Department.
- C. Architect Identification: The Contract Documents were prepared for Project by WBRC Architects – Engineers, 141 Prebble Street, Portland, Maine 04101.
- D. The Work consists of the following:
  - 1. The Work involves the construction of a new Elementary School, of approximately 70,315 square feet, at location indicated on Drawings. Work includes but is not limited to, earthwork, site utilities and site improvements, paving, and landscaping. Work also includes concrete foundations and slab-on-grade, steel structure, steel joists and decking, roof membrane over roof insulation, green roof system, sheet metal, masonry, metal stud partitions, insulation, gypsum board walls and ceilings, ceramic tile, acoustical ceilings, resilient flooring, carpeting, custom cabinets and fixtures, carpentry, glass storefront system, painting, metal doors, wood doors, metal frames, door hardware, overhead coiling doors, metal fabrications, toilet partitions and accessories, signage, lockers, fire protection and detection systems, security systems, electrical, and heating, ventilating, and air conditioning complete and ready for use.

#### 1.4 TYPE OF CONTRACT

- A. Project will be constructed under a single prime contract.
- B. Contract Type: State of Maine - Section 2-E, Contract Agreement (Public Schools Projects).

#### 1.5 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.
- B. Concurrent Work: Owner will award separate contracts for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
  - 1. Asbestos Abatement: A separate contract will be awarded to for asbestos abatement during the building demolition. A copy of the Hazardous Material assessment report will be made available for contractors if requested.
  - 2. Sewer Separation: A separate contract will be awarded for the separation of sewer and storm drainage.
  - 3. Playground Equipment: A separate contract will be awarded for the supply and installation of playground equipment.

#### 1.6 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes providing support systems to receive Owner's equipment.
  - 1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.
  - 2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
  - 3. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
  - 4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
  - 5. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
  - 6. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
  - 7. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.
  - 8. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
  - 9. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
  - 10. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.
  - 11. Contractor shall install and otherwise incorporate Owner-furnished items into the Work.
- B. Owner-Furnished, Contractor Installed Products:
  - 1. Selected Toilet Accessories.
  - 2. Selected residential appliances.



3. Projector mounts.

C. Owner-Furnished, Owner Installed Products:

1. Projectors.
2. Smart boards.

1.7 USE OF PREMISES

- A. General: Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Use of Site: Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1.8 WORK RESTRICTIONS

- A. On-Site Work Hours: Work shall be generally performed inside the existing building during normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except otherwise indicated.
  1. Weekend Hours: As approved by Architect and Owner.
  2. Early Morning Hours: As approved by Architect and Owner.
  3. Provide 24 hour notice to Architect when performing work other than normal working hours.
- B. Nonsmoking Construction Site: Smoking is not permitted on the site.

1.9 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 49-division format and CSI/CSC's "MasterFormat" numbering system.
  1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
  2. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
  2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative

or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

## SECTION 012100 - ALLOWANCES

## 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 governing allowances.
  - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
  - 1. Lump-sum allowances.
  - 2. Unit-cost allowances.
  - 3. Quantity allowances.
- C. Related Sections include the following:
  - 1. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders for allowances.
  - 2. Division 01 Section "Unit Prices" for procedures for using unit prices.
  - 3. Division 01 Section "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.
  - 4. Divisions 02 through 49 Sections for items of Work covered by allowances.

## 1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

## 1.4 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

#### 1.5 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

#### 1.6 LUMP-SUM UNIT-COST AND QUANTITY ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Return unused Lump Sum amounts for credit to Owner.

#### 1.7 TESTING AND INSPECTING ALLOWANCES

- A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
- B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.
- C. Costs of services not required by the Contract Documents are not included in the allowance.
- D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

#### 1.8 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
  - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
  - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
  - 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
  - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
  - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
  - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Include \$15,000 to provide interior signage. This does not include signage as provided in Section 101400.
- B. Allowance No. 2: Include \$25,000 for Excess Electrical Utility Allowance.

END OF SECTION 012100

## SECTION 012200 - UNIT PRICES

## 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 unit prices.
- B. Related Sections include the following:
  - 1. Division 01 Section "Allowances" for procedures for using unit prices to adjust quantity allowances.
  - 2. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
  - 3. Division 01 Section "Quality Requirements" for general testing and inspecting requirements.

## 1.3 DEFINITIONS

- A. Unit price is an amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

## 1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A list of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

## 3.1 LIST OF UNIT PRICES

## A. Unit Price No. 1 – Excavation and Removal:

1. Description: Excavation of material and removal from site, both unsuitable and excess.
2. Unit of Measurement: Cu. yard of excavated material.

## B. Unit Price No. 2 – Excavation and Backfill (open):

1. Description: Excavation and backfill with excavated material according to Division 31 Section "Earth Moving."
2. Unit of Measurement: Cu. yard of excavated material.

## C. Unit Price No. 3 – Excavation and Backfill (trench):

1. Description: Excavation and backfill with excavated material according to Division 31 Section "Earthwork."
2. Unit of Measurement: Cu. yard of excavated material.

## D. Unit Price No. 4 – Rock Excavation and Removal and replacement with approved materials to subgrade (open):

1. Description: Rock excavation, including removal from site.
2. Unit of Measurement: Cu. yard of excavated material.

## E. Unit Price No. 5 – Rock Excavation and Removal and replacement with approved materials to subgrade (trench):

1. Description: Rock excavation, including removal from site.
2. Unit of Measurement: Cu. yard of excavated material.

## F. Unit Price No. 6 – Granular Borrow Fill:

1. Description: Granular borrow fill and backfill in place.
2. Unit of Measurement: Cu. yard of granular borrow material.

## G. Unit Price No. 7 – Gravel Base:

1. Description: Gravel base, in place.
2. Unit of Measurement: Cu. yard of gravel material.

## H. Unit Price No. 8 – Gravel Subbase:

1. Description – Gravel Subbase, in place.
2. Unit of Measurement Cu.yard of gravel material

## I. Unit Price No 9 – Bio-Retention bed underdrain material

1. Description: granular material for underdrain bedding, in place.
2. Unit of Measurement: Cu. yard of underdrain granular bedding material.

- J. Unit Price No. 10 – Bituminous Pavement – HMA 12.5 mm:
1. Description: Bituminous pavement – HMA 12.5 mm, compacted in place.
  2. Unit of Measurement: Per ton.
- K. Unit Price No. 11 – Bituminous Pavement – HMA 19.0 mm:
1. Description: Bituminous pavement – HMA 19.0 mm, compacted in place.
  2. Unit of Measurement: Per ton
- L. Unit Price No. 12 – 4” perforated Type B Underdrain
1. Description: 4” perforated Type B Underdrain.
  2. Unit of Measurement: linear foot
- M. Unit Price No. 13 – 12” corrugated Polyethylene pipe (smooth lined)
1. Description: . 12” corrugated Polyethylene pipe (smooth lined)
  2. Unit of Measurement: linear foot
- N. Unit Price No. 14 – Impervious pond liner
1. Description Impervious pond liner
  2. Unit of Measurement square foot

END OF SECTION 012200



## SECTION 012300 - ALTERNATES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

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

## 1.3 DEFINITIONS

- A. Alternates: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

## 1.4 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
  - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

## 3.1 SCHEDULE OF ALTERNATES

## A. Alternate #1: City Sewer Connection

1. Base Bid: Connect building sewer to new City manhole as shown on project drawings. Outside drop at the City manhole is part of the school project.
2. Alternate: Connect building sewer to existing City line on south side of the parcel to meet City design standards. This connection will not be at a manhole.

## B. Alternate #2: Bleachers

1. Base Bid: Do not provide Bleachers.
2. Alternate: Provide Bleachers as indicated in the Contract Documents.

## C. Alternate #3: Stage Curtains

1. Base Bid: Do not provide Stage Curtains.
2. Alternate: Provide Stage Curtains as indicated in the Contract Documents.

## D. Alternate #4: Graffiti Protection.

1. Base Bid: Do not provide Graffiti Protection.
2. Alternate: Provide Graffiti Protection to a height of 10 feet above finished grade at the perimeter of the building.

## E. Alternate #5: Upgraded Stage Lighting.

1. Base Bid: Provide Stage Lighting as indicated in the Contract Documents.
2. Alternate: Provide upgraded Stage Lighting as indicated in the Contract Documents.

## F. Alternate #6: Upgraded Phone System.

1. Base Bid: Provide Phone System as indicated in the Contract Documents.
2. Alternate: Provide upgraded Phone System as indicated in the Contract Documents.

END OF SECTION 012300

## SECTION 012500 - SUBSTITUTION 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 administrative and procedural requirements for substitutions.
- B. Related Sections:
  - 1. Division 01 Section "Allowances" for products selected under an allowance.
  - 2. Division 01 Section "Alternates" for products selected under an alternate.
  - 3. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
  - 4. Divisions 02 through 49 Sections for specific requirements and limitations for substitutions.

## 1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

## 1.4 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use facsimile of form provided at end of Section.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
    - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant

qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
  - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within three days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution by addendum.
- a. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated or notification is not made by addendum.

## 1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.
- B. Products with asbestos: Asbestos containing materials are not to be purchased or installed in this project.

## 1.6 PROCEDURES

- A. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

## PART 2 - PRODUCTS

### 2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
  - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - b. Substitution request is fully documented and properly submitted.
  - c. Requested substitution will not adversely affect Contractor's construction schedule.
  - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
  - e. Requested substitution is compatible with other portions of the Work.
  - f. Requested substitution has been coordinated with other portions of the Work.
  - g. Requested substitution provides specified warranty.
  - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
  
- B. Substitutions for Convenience: Article 9 of Section 3-A, Conditions of the Contract, specify time restrictions for submitting requests for Substitutions during the bidding period to requirements specified in this section. Requests received after that time may be considered or rejected at discretion of Architect.
  1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
    - b. Requested substitution does not require extensive revisions to the Contract Documents.
    - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - d. Substitution request is fully documented and properly submitted.
    - e. Requested substitution will not adversely affect Contractor's construction schedule.
    - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - g. Requested substitution is compatible with other portions of the Work.
    - h. Requested substitution has been coordinated with other portions of the Work.
    - i. Requested substitution provides specified warranty.
    - j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

## PART 3 - EXECUTION (Not Used)

SUBSTITUTION REQUEST FORM

Project: \_\_\_\_\_ Substitution Request Number: \_\_\_\_\_  
To: \_\_\_\_\_ From: \_\_\_\_\_  
Re: \_\_\_\_\_ Date: \_\_\_\_\_

Specification Title: \_\_\_\_\_ Description: \_\_\_\_\_  
Section: \_\_\_\_\_ Page: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone: \_\_\_\_\_  
Trade Name: \_\_\_\_\_ Model No. \_\_\_\_\_

Attached data includes product description, specifications, drawings, and performance and test data adequate for evaluation of the request: applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitutions will require for its proper installation.

The Undersigned certifies:

1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the Substitution as for the specified Product.
3. Will provide no additional cost to the Owner.
4. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
5. Waive claims for additional costs or time extension that may subsequently become apparent.
6. Will reimburse Owner and Architect/Engineer for review or redesign services associated with substitution.

Submitted By: \_\_\_\_\_  
Signed By: \_\_\_\_\_  
Firm: \_\_\_\_\_  
Address: \_\_\_\_\_  
Telephone: \_\_\_\_\_ Fax: \_\_\_\_\_

A/E's REVIEW AND ACTION

- Submission approved - Make submittals in accordance with Specification Section 01330.
- Submission approved as noted - Make submittals in accordance with Specification Section 01330.
- Submission rejected - Use specified materials.
- Submission request received too late - Use specified materials.

Signed by: \_\_\_\_\_ Date: \_\_\_\_\_

Supporting Data Attached:  Drawings  Product Data  Samples  Tests  Reports  
 Other \_\_\_\_\_

END OF SECTION 012500

## SECTION 012600 - CONTRACT MODIFICATION 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 for handling and processing Contract modifications.
- B. Related Sections include the following:
  - 1. Division 01 Section "Allowances" for procedural requirements for handling and processing allowances.
  - 2. Division 01 Section "Unit Prices" for administrative requirements for using unit prices.
  - 3. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

## 1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
  - 2. Within 14 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Architect on Change Order Request form.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.
7. Change Order Request Form: Use CSI Form 13.6A "Change Order Request (Proposal)" with attachments CSI Form 13.6B "Proposal Worksheet Summary" and 13.6C "Proposal Worksheet Detail" or similar form approved by Owner.

#### 1.4 ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, base each Change Order proposal on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
1. Include installation costs in purchase amount only where indicated as part of the allowance.
  2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
  3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
  4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 10 days of receipt of the Change Order or Construction Change Directive authorizing work to proceed. Owner will reject claims submitted later than 21 days after such authorization.
1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
  2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

#### 1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on form provided by the Owner.



PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

## 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 "Allowances" for procedural requirements governing handling and processing of allowances.
  - 2. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 3. Division 01 Section "Unit Prices" for administrative requirements governing use of unit prices.
  - 4. 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 (CONTRACT COST BREAKDOWN)

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
  - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
    - a. Application for Payment forms with Continuation Sheets.
    - b. Submittals Schedule.
    - c. Contractor's Construction Schedule.
  - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
  - 3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:
  - a. Project name and location.
  - b. Name of Architect.
  - c. Architect's project number.
  - d. Contractor's name and address.
  - e. Date of submittal.
2. Submit draft of Form provided by the Owner or Contractors Electronic form.
3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
  - a. Related Specification Section or Division.
  - b. Description of the Work.
  - c. Name of subcontractor.
  - d. Name of manufacturer or fabricator.
  - e. Name of supplier.
  - f. Change Orders (numbers) that affect value.
  - g. Dollar value.
    - 1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate. Include separate line items under required principal subcontracts for operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training in the amount of 5 percent of the Contract Sum.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
  - a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.
7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
9. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
  - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
10. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

## 1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Forms: Use forms provided by Owner for Applications for Payment or Contractor's electronic media driven form, including continuation sheets when required, 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. The list of subcontractors, principal suppliers and fabricators shall be used to designate which entities involved in the Work must submit waivers. The list shall be approved by the Owner.
  4. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  5. 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.
  6. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of Values.
  3. Contractor's Construction Schedule (preliminary if not final).
  4. Products list.
  5. Schedule of unit prices.

6. Submittals Schedule (preliminary if not final).
  7. List of Contractor's staff assignments.
  8. List of Contractor's principal consultants.
  9. Copies of building permits.
  10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  11. Initial progress report.
  12. Certificates of insurance and insurance policies.
  13. Data needed to acquire Owner's insurance.
  14. Initial settlement survey and damage report if required.
- H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Final submittal of record documents and operation and maintenance data.
  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. Evidence that claims have been settled.
  6. 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.
  7. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. Administrative and supervisory personnel.
  - 2. Project meetings.
  - 3. Requests for Interpretation (RFIs).
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.
- C. Related Sections include the following:
  - 1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
  - 2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

## 1.3 DEFINITIONS

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

## 1.4 COORDINATION

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

- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's Construction Schedule.
  - 2. Preparation of the Schedule of Values.
  - 3. Installation and removal of temporary facilities and controls.
  - 4. Delivery and processing of submittals.
  - 5. Progress meetings.
  - 6. Preinstallation conferences.
  - 7. Project closeout activities.
  - 8. Startup and adjustment of systems.
  - 9. Project closeout activities.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

#### 1.5 SUBMITTALS

- A. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
  - 1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

#### 1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.
  - 1. Include special personnel required for coordination of operations with other contractors.

#### 1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
  - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.

2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing and long-lead items.
    - d. Designation of key personnel and their duties.
    - e. Procedures for processing field decisions and Change Orders.
    - f. Procedures for RFIs.
    - g. Procedures for testing and inspecting.
    - h. Procedures for processing Applications for Payment.
    - i. Distribution of the Contract Documents.
    - j. Submittal procedures.
    - k. LEED requirements.
    - l. Construction waste management.
    - m. Construction indoor air quality.
    - n. Closeout procedures.
    - o. Preparation of Record Documents.
    - p. Use of the premises.
    - q. Work restrictions.
    - r. Owner's occupancy requirements.
    - s. Responsibility for temporary facilities and controls.
    - t. Construction waste management and recycling.
    - u. Parking availability.
    - v. Office, work, and storage areas.
    - w. Equipment deliveries and priorities.
    - x. First aid.
    - y. Security.
    - z. Progress cleaning.
    - aa. Working hours.
  3. Minutes: Architect will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. The Contract Documents.



- b. Options.
  - c. Related RFIs.
  - d. Related Change Orders.
  - e. Purchases.
  - f. Deliveries.
  - g. Submittals.
  - h. Review of mockups.
  - i. Possible conflicts.
  - j. Compatibility problems.
  - k. Time schedules.
  - l. Weather limitations.
  - m. Manufacturer's written recommendations.
  - n. Warranty requirements.
  - o. Compatibility of materials.
  - p. Acceptability of substrates.
  - q. Temporary facilities and controls.
  - r. Space and access limitations.
  - s. Regulations of authorities having jurisdiction.
  - t. Testing and inspecting requirements.
  - u. Installation procedures.
  - v. Coordination with other work.
  - w. Required performance results.
  - x. Protection of adjacent work.
  - y. Protection of construction and personnel.
- 3. Architect will record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  - 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
  - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at monthly intervals. Coordinate dates of meetings with preparation of payment requests.
- 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.

- 2) Sequence of operations.
  - 3) Status of submittals.
  - 4) Deliveries.
  - 5) Off-site fabrication.
  - 6) Access.
  - 7) Site utilization.
  - 8) Temporary facilities and controls.
  - 9) Work hours.
  - 10) Hazards and risks.
  - 11) Progress cleaning.
  - 12) Quality and work standards.
  - 13) Status of correction of deficient items.
  - 14) Field observations.
  - 15) RFIs.
  - 16) Status of proposal requests.
  - 17) Pending changes.
  - 18) Status of Change Orders.
  - 19) Pending claims and disputes.
  - 20) Documentation of information for payment requests.
  - 21) LEED submittals and requirements.
  - 22) Construction waste management.
  - 23) Construction indoor air quality.
3. Minutes: Architect will record and distribute to Contractor the meeting minutes.
  4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
    - a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- E. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - b. Schedule Updating: Revise Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    - c. Review present and future needs of each contractor present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.

- 3) Status of submittals.
  - 4) Deliveries.
  - 5) Off-site fabrication.
  - 6) Access.
  - 7) Site utilization.
  - 8) Temporary facilities and controls.
  - 9) Work hours.
  - 10) Hazards and risks.
  - 11) Progress cleaning.
  - 12) Quality and work standards.
  - 13) Change Orders.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

#### 1.8 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
  2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
1. Project name.
  2. Date.
  3. Name of Contractor.
  4. Name of Architect.
  5. RFI number, numbered sequentially.
  6. Specification Section number and title and related paragraphs, as appropriate.
  7. Drawing number and detail references, as appropriate.
  8. Field dimensions and conditions, as appropriate.
  9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  10. Contractor's signature.
  11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
    - a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- C. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:
  - a. Requests for approval of submittals.
  - b. Requests for approval of substitutions.
  - c. Requests for coordination information already indicated in the Contract Documents.
  - d. Requests for adjustments in the Contract Time or the Contract Sum.
  - e. Requests for interpretation of Architect's actions on submittals.
  - f. Incomplete RFIs or RFIs with numerous errors.
2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
  - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
  1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. RFI number including RFIs that were dropped and not submitted.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.
  8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
  9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

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

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Material location reports.
6. Field condition reports.
7. 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 DEFINITIONS

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

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

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

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

- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
- G. Fagnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- H. Major Area: A story of construction, a separate building, or a similar significant construction element.
- I. Milestone: A key or critical point in time for reference or measurement.
- J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

#### 1.4 SUBMITTALS

- A. Qualification Data: For scheduling consultant, if used.
- 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 opaque copies.
  - 1. Approval of cost-loaded preliminary construction schedule will not constitute approval of Schedule of Values for cost-loaded activities.
- D. Preliminary Network Diagram: Submit two opaque copies, large enough to show entire network for entire construction period. Show logic ties for activities.
- E. Contractor's Construction Schedule: Submit two opaque copies of initial schedule, large enough to show entire schedule for entire construction period.
- F. CPM Reports: Concurrent with CPM schedule, submit three copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
  - 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.

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

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

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

## 1.5 QUALITY ASSURANCE

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

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

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

## 1.6 COORDINATION

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

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

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

## PART 2 - PRODUCTS

### 2.1 SUBMITTALS SCHEDULE

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

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

## 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established for 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. 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.
  3. Startup and Testing Time: Include not less than 5 days for startup and testing.
  4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
  1. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  2. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Partial occupancy before Substantial Completion.
    - b. Seasonal variations.
    - c. Environmental control.
  3. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
    - a. Subcontract awards.
    - b. Submittals.
    - c. Purchases.
    - d. Mockups.
    - e. Fabrication.
    - f. Sample testing.
    - g. Deliveries.



- h. Installation.
  - i. Tests and inspections.
  - j. Adjusting.
  - k. Curing.
  - l. Startup and placement into final use and operation.
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. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- F. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
- 1. Refer to Division 01 Section "Payment Procedures" for cost reporting and payment procedures.
  - 2. Contractor shall assign cost to construction activities on the CPM schedule. Costs shall not be assigned to submittal activities unless specified otherwise but may, with Architect's approval, be assigned to fabrication and delivery activities. Costs shall be under required principal subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
  - 3. Each activity cost shall reflect an accurate value subject to approval by Architect.
  - 4. Total cost assigned to activities shall equal the total Contract Sum.
- G. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

### 2.3 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within seven days of date established for commencement of the Work.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

### 2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Preliminary Network Diagram: Submit diagram within 14 days of date established for commencement of the Work. Outline significant construction activities for the first 60 days of construction. Include

skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

- C. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for commencement of the Work.
    - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
  2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
  3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
  4. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
    - a. Preparation and processing of submittals.
    - b. Mobilization and demobilization.
    - c. Purchase of materials.
    - d. Delivery.
    - e. Fabrication.
    - f. Utility interruptions.
    - g. Installation.
    - h. Work by Owner that may affect or be affected by Contractor's activities.
    - i. Testing and commissioning.
  2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
  3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
  4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
    - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
  2. Description of activity.
  3. Principal events of activity.
  4. Immediate preceding and succeeding activities.
  5. Early and late start dates.

6. Early and late finish dates.
  7. Activity duration in workdays.
  8. Total float or slack time.
  9. Average size of workforce.
  10. Dollar value of activity (coordinated with the Schedule of Values).
- F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
  2. Changes in early and late start dates.
  3. Changes in early and late finish dates.
  4. Changes in activity durations in workdays.
  5. Changes in the critical path.
  6. Changes in total float or slack time.
  7. Changes in the Contract Time.
- G. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
  2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
  3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
  4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
    - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
    - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

## 2.5 REPORTS

- A. 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.

## 2.6 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner 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. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
  - 1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
  - 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- B. Contractor's Construction Schedule Updating: At monthly intervals, review schedule for actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
  - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  - 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- C. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
  - 1. Post copies in Project meeting rooms and temporary field offices.
  - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

## SECTION 013300 - SUBMITTAL PROCEDURES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections include the following:
  - 1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
  - 2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
  - 3. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
  - 4. Division 01 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
  - 5. Division 01 Section "Closeout Procedures" for submitting warranties.
  - 6. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 7. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
  - 8. Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.
  - 9. Divisions 02 through 49 Sections for specific requirements for submittals in those Sections.

## 1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

## 1.4 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings may be provided by Architect for Contractor's use in preparing submittals. Contact Architect for additional information.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 15 days for review of each resubmittal.
  4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
    - a. Sitework submittals.
    - b. Commercial equipment submittals.
    - c. Structural submittals.
    - d. Mechanical submittals.
    - e. Electrical submittals.
    - f. Data & Communications Systems submittals.
  5. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
  6. Submittals with Color Selections: Deliver to Architect a list of submittals required for the exterior color package and a list required for the interior color package. The Architect needs to coordinate the colors of all exterior and interior items and will hold submittals with color selections until all materials in the exterior color package have been received. Allow 2 weeks after the last item has been submitted for return of exterior color selections. The Architect will hold submittals with color selections until all materials in the interior color package have been received. Allow 3 weeks after the last item has been submitted for return of interior color selections. Careful coordination of the Submittal Schedule by the Contractor is required so as not to delay the Work.
- E. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
  2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
  3. Include the following information on label for processing and recording action taken:
    - a. Project name.
    - b. Date.

- c. Name and address of Architect.
  - d. Name and address of Contractor.
  - e. Name and address of subcontractor.
  - f. Name and address of supplier.
  - g. Name of manufacturer.
  - h. Submittal number or other unique identifier, including revision identifier.
    - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
  - i. Number and title of appropriate Specification Section.
  - j. Drawing number and detail references, as appropriate.
  - k. Location(s) where product is to be installed, as appropriate.
  - l. Other necessary identification.
- F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
- 1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
  - 2. Additional copies submitted for maintenance manuals will be marked with action taken and will be returned.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
- 1. Transmittal Form: Use Contractor's standard transmittal form. Provide locations on form for the following information:
    - a. Project name.
    - b. Date.
    - c. Destination (To:).
    - d. Source (From:).
    - e. Names of subcontractor, manufacturer, and supplier.
    - f. Category and type of submittal.
    - g. Submittal purpose and description.
    - h. Specification Section number and title.
    - i. Drawing number and detail references, as appropriate.
    - j. Transmittal number, numbered consecutively.
    - k. Submittal and transmittal distribution record.
    - l. Remarks.
    - m. Signature of transmitter.
  - 2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block and clearly indicate extent of revision.
- J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- K. Use for Construction: Use only final submittals with mark indicating "Reviewed, No Exceptions Taken" taken by Architect.

## PART 2 - PRODUCTS

### 2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's written recommendations.
    - b. Manufacturer's product specifications.
    - c. Manufacturer's installation instructions.
    - d. Standard color charts.
    - e. Manufacturer's catalog cuts.
    - f. Wiring diagrams showing factory-installed wiring.
    - g. Printed performance curves.
    - h. Operational range diagrams.
    - i. Mill reports.
    - j. Standard product operation and maintenance manuals.
    - k. Compliance with specified referenced standards.
    - l. Testing by recognized testing agency.
    - m. Application of testing agency labels and seals.
    - n. Notation of coordination requirements.
  4. Submit Product Data before or concurrent with Samples.
  5. Number of Copies: Submit three copies of Product Data, unless otherwise indicated. Architect will return one copy. Mark up and retain one returned copy as a Project Record Document.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Architect's CAD Drawings are otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Dimensions.
    - b. Identification of products.
    - c. Fabrication and installation drawings.



- d. Roughing-in and setting diagrams.
  - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
  - f. Shopwork manufacturing instructions.
  - g. Templates and patterns.
  - h. Schedules.
  - i. Design calculations.
  - j. Compliance with specified standards.
  - k. Notation of coordination requirements.
  - l. Notation of dimensions established by field measurement.
  - m. Relationship to adjoining construction clearly indicated.
  - n. Seal and signature of professional engineer if specified.
  - o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
  3. Number of Copies: Submit 1 copy and 1 reproducible. Architect will return reproducible.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of appropriate Specification Section.
  3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit three full sets of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return one submittal with options selected.
  5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

- a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
  - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
  - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation" for Architect's action.
- F. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.
  - 3. Drawing number and detail references, as appropriate, covered by subcontract.
  - 4. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Architect will return two copies.
    - a. Mark up and retain one returned copy as a Project Record Document.

## 2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
  - 1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
  - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
  - 3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

- D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- E. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- G. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- J. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- K. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - 1. Name of evaluation organization.
  - 2. Date of evaluation.
  - 3. Time period when report is in effect.
  - 4. Product and manufacturers' names.
  - 5. Description of product.
  - 6. Test procedures and results.
  - 7. Limitations of use.
- L. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- M. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- N. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- O. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

- P. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- Q. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- R. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
  2. Required substrate tolerances.
  3. Sequence of installation or erection.
  4. Required installation tolerances.
  5. Required adjustments.
  6. Recommendations for cleaning and protection.
- S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- T. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- U. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.
1. Architect will not review submittals that include MSDSs and will return the entire submittal for resubmittal.

### 2.3 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, 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. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
  1. Stamp or statement shall include the following: "The Contractor represents that he has determined and verified all materials, field measurements, and field construction criteria related thereto or will do so, and that he has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents."

#### 3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
  1. Reviewed, No Exceptions Taken: Final Unrestricted Release. Work may proceed, provided it complies with the Contract Documents.
  2. Reviewed, Revise as Noted: Final But Conditional Release. Work may proceed, provided it complies with the notations and corrections on submittals and with Contract Documents. Architect's comments shall be considered a part of the original submittal. Should Contractor disagree with any such comments, so notify the Architect within fourteen (14) days after receipt of such transmittal and before commencing work on the items in question. Failing this, Contractor shall be deemed to have agreed to such comments by the Architect and to have accepted full responsibility for implementing them at no additional cost to the Owner.
  3. Revise and Resubmit: Returned for Resubmittal. Do not proceed with the work at the site or allow submittal at site. Fabrication in shop or factory may proceed on items not affected by the Architect's comments only. Revise submittal in accordance with notations thereon, and resubmit without delay to obtain a different action marking. Revise and Resubmit
  4. Rejected: Where submittal is returned for other reasons, with Architect's explanation included.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

## SECTION 013310 - ADDITIONAL SUBMITTAL REQUIREMENTS

## PART 1 - GENERAL

## 1.1 INSTRUCTIONS FOR GENERAL CONTRACTOR TRANSMITTAL LETTER (per sample attached)

- A. Header information to be entered:
  - 1. Date
  - 2. GC's name/address/phone-fax
  - 3. WBRC A/E Project #/Comm. # and the WBRC A/E Project Name/Job Title
  - 4. Division # (*only one Division per transmittal, NO EXCEPTIONS*)
  - 5. GC's Transmittal # (see spec section 01330 for numbering details)
  - 6. Sub-contractor/Supplier name
  
- B. Line item information
  - 1. 1 Specification Section per transmittal is preferred
  - 2. 8 items only per transmittal
  - 3. Using 1 line for each item being submitted, enter the following:
    - a. # of copies
    - b. Spec Section #;
    - c. Part 1 Submittal Pgh.# (indicates what type of submittal it is)
    - d. Part 2 Products Pgh.# (indicates description of the submittal item)
    - e. Item Code Letter (sequential alphabet letters A,B,C, etc., one for each item)
    - f. TYPE of submittal (prod data, sample, etc.)
    - g. DESCRIPTION of item submitted (brick, siding, etc.)
      - 1) Information stapled together in one packet is a single item, and gets one Code Letter
      - 2) Leave the last column blank for the WBRC reviewer to complete
  
- C. Specific Transmittal information
  - 1. Indicate the purpose of the transmittal, relevant comments, instructions, then sign the Transmittal Letter

## 1.2 INSTRUCTIONS FOR EACH SUBMITTAL ITEM (per sample attached)

- A. Stamp the front/top page of EACH submittal item with the General Contractor's review stamp
  - 1. Make sure there is enough clear space on the top page for both the GC and the WBRC review stamps
    - a. If there is not enough room, use a cover sheet attached to the front of each submittal item
    - b. Samples also need to have a GC review stamp
    - c. Do not fold back the top page; do not stamp over product information/drawing lines/etc.
    - d. Complete all appropriate information, then sign the GC review stamp to show it has been reviewed
  
- B. Write in the corresponding "Item Code Letter" from the transmittal letter
  - 1. Mark appropriate code letters (A,B,C,etc.) on each corresponding submittal item, including samples, near the GC review stamp
  
- C. Use black or red marks (arrows, circles, bubbles) to indicate specific product information
  - 1. Do not use yellow highlighting that does not show up when photocopied
  
- D. Bundle each set of submittal items together (all item "A" submittals bundled together, all item "B" submittals bundled together, etc.)

## 1.3 OTHER GENERAL INSTRUCTIONS

- A. Comply with all other criteria listed in Section 01330 – Submittal Procedures.

PART 2 – PRODUCTS (not used)

PART 3 – EXECUTION (not used)

END OF SECTION 013310

Date: January 24, 2005

## SUBMITTAL TRANSMITTAL LETTER

### SAMPLE CONSTRUCTION COMPANY

Company Name  
123 TEST STREET – ANYCITY MAINE 04000  
 Company Address  
 phone(000) 000-0000; fax(000) 000-0000  
 Telephone/Fax Number

SAMPLE

TO: WBRC Architects-Engineers  
 44 Central Street  
 Bangor, ME 04401

RE: A/E Comm. #: 9999.00  
 Division #: 07  
 G.C. Transmittal #: 07-14

A/E Job Title: Sample Project  
 Sub-contractor/Supplier: ABC Product Company

**WE ARE SENDING YOU THE ATTACHED ITEMS:**

#Copies	Spec Section#	Part1 Pgh#	Part2 Pgh#	GC Code Letter*	Type of item / DESCRIPTION	WBRC Review # **
6	07210	1.2.A	2.2.D	A	Product data- fiberglass insulation	
6	07210	1.2.B.1	2.2.D	B	Certification for LEED, MR#4.1 for pre/post consumer content - fiberglass insulation	

THESE ARE TRANSMITTED as checked below:

<input checked="" type="checkbox"/>	For Review & Comment	<input type="checkbox"/>	For Your Use/File	<input type="checkbox"/>	As Requested	<input type="checkbox"/>	Resubmittal
Other: _____							

**COMMENTS:**

*Please note:  
 Manufacturer of previous submittal product data does not have LEED information available, so we are substituting this product as comparable.*

COPY TO:

SIGNED: John Jones

\* GC to also mark the appropriate code letter (A,B,C,etc.) on **each** corresponding submittal item next to your GC stamp.  
 \*\* This column to be completed by the WBRC reviewer when returning to the GC using corresponding review number(s) :  
 1- Reviewed, No Exception Taken; 2- Reviewed, Revise as Noted; 3- Revise and Resubmit; 4- Rejected



# Submittal Form

SHOP DRAWING REVIEW	
REVIEWED	<input checked="" type="checkbox"/>
TAKE CORRECTIONS NOTED	<input type="checkbox"/>
AMEND & RESUBMIT	<input type="checkbox"/>
REJECTED - SEE REMARKS	<input type="checkbox"/>
<small>PERMITTED TO BE USED FOR CONSTRUCTION ONLY. THIS DRAWING IS NOT TO BE REPRODUCED OR COPIED IN ANY MANNER WITHOUT THE WRITTEN PERMISSION OF THE ARCHITECT. CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS. INFORMATION PERTAINING TO THIS PROJECT IS THE PROPERTY OF THE ARCHITECT AND IS NOT TO BE DISCLOSED TO ANY OTHER PARTY WITHOUT THE WRITTEN PERMISSION OF THE ARCHITECT.</small>	
DATE <u>2/13/05</u>	

<input checked="" type="checkbox"/> Reviewed, No Exception Taken	<input type="checkbox"/> Reviewed, Revise As Noted
<input checked="" type="checkbox"/> Revise and Resubmit	<input type="checkbox"/> Rejected
(Check mark designates action taken) WBRC Architects Engineers 44 Central Street, Bangor, ME 04401	
See Section on "Submittals" of the specifications, and limitations of this review, and responsibility of the contractor. In no case are quantities guaranteed. Review is not to be construed as permitting omission of the specified details necessary or specified but not specifically detailed or mentioned on the reviewed drawings.	
Date <u>2-5-05</u>	By <u>MJ</u>

# CertainTeed

## Fiber Glass Insulation Products

Room for WBRC's review stamp

corresponding item code letter written in

Room for GC's review stamp

Submitted to: SAMPLE CONSTRUCTION COMPANY

Job Name: SAMPLE PROJECT

Submitted by: BUILDERS INSULATION

Date: mm/dd/yy

This Submittal Form is provided to assist you in specifying and selecting the proper CertainTeed Insulation product. Basic product descriptions and performance data are included. For further information or technical assistance, contact your local CertainTeed Sales Office.

CertainTeed Corporation  
 P.O. Box 860  
 Valley Forge, PA 19482

Product	Description	Thermal Resistance* / Nominal Thickness	Applicable Standards
Unfaced Building Insulation	Manufactured in widths to permit pressure fit installation. Used with a separate vapor barrier or where no vapor barrier is required or recommended.	R-38 / 12" R-30 / 10" R-22 / 6 1/2" R-19 / 6 1/2" R-13 / 3 1/2" R-11 / 3 1/2"	Complies with ASTM C 405 Type I (replaces Fed. Spec. HH-1-521F, cancelled 1984). Is noncombustible meeting test criteria of ASTM E 136. Thermal performance determined by ASTM C 653 & C 518.
Kraft Faced Building Insulation	Manufactured with a flanged, kraft paper facing providing a vapor barrier with a perm rating of 1.0 or less.	R-38 / 12" R-30 / 10" R-22 / 6 1/2" R-19 / 6 1/2" R-13 / 3 1/2" R-11 / 3 1/2"	Complies with ASTM C 405, Type II, Class C (replaces Fed. Spec. HH-1-521F, cancelled 1984). Thermal performance determined by ASTM C 653 & C 518.
Foil Faced Build Insulation	Manufactured with a flanged foil vapor barrier providing a perm rating of 0.1 or less.	R-19 / 6 1/4" R-11 / 3 1/2"	Complies with ASTM C 665, Type III, Class B (replaces Fed. Spec. HH-1-521F, cancelled 1984). Thermal performance determined by ASTM C 653 & C 518.
Flame Resis FSK Build Insulation	Manufactured with a flame resistant foil facing. Used where a flame spread rating of 25 or less is required for insulation facings. The FSK Facing has a perm rating of 0.03 or less.	R-19 / 6 1/4" R-11 / 3 1/2"	Complies with ASTM C 665, Type III, Class A (replaces Fed. Spec. HH-1-521F, cancelled 1984). Thermal performance determined by ASTM C 653 & C 518.
Sound Control Batt	Unfaced batts manufactured in widths to permit pressure fit installation in wood or metal stud systems.	R-11 / 3 1/2" R-8 / 2 1/2"	Complies with ASTM C 665, Type I (replaces Fed. Spec. HH-1-521F, cancelled 1984). Thermal performance determined by ASTM C 653 & C 518.
Acoustic Batt	Ceiling 24" x 48" batts with an unflanged kraft paper facing. For use in suspended ceiling systems.	R-19 / 6 1/4" R-11 / 3 1/2"	Complies with ASTM C 665, Type II, Class C (replaces Fed. Spec. HH-1-521F, cancelled 1984). Thermal performance determined by ASTM C 653 & C 518.
Masonry Batt	all Unfaced batts designed for use behind paneling in masonry-type construction where cavity depth is limited by the furring strips. Used with a separate vapor barrier or where no vapor barrier is required or recommended.	R-3 / 1/4" R-6 / 1 1/4"	Complies with ASTM C 665, Type I (replaces Fed. Spec. HH-1-521F, cancelled 1984). Is noncombustible meeting test criteria of ASTM E 136. Thermal performance determined by ASTM C 653 and C 518.

Specific product info clearly marked

Specific product info clearly marked

\*R means resistance to heat flow. The higher the R value, the greater the insulating power.

\*(West Coast Only)

Insulation Group  
CertainTeed Corporation  
750 E. Swedestord Road  
PO Box 860  
Valley Forge, PA  
610-341-7000

SHOP DRAWING REVIEW	
REVIEWED	<input checked="" type="checkbox"/>
MAKE CORRECTIONS NOTED	
AMEND & RESUBMIT	
REJECTED-SEE REASON	
<small>PERMITTEE SHALL BE RESPONSIBLE FOR INFORMATION AND TO THE FACILITATION OF INSPECTOR TO SUCCESSFUL OR TO SAFETY REQUIREMENTS.</small>	
SIGNATURE	DATE
<i>[Signature]</i>	1/23/05



December 29, 2004

Room for GC's review stamp →

Corresponding item code letter written in → **(B)**

SAMPLE PROJECT  
Contractor: *[Signature]*  
Company: *[Signature]*

Product: R-19 and R-30 Fiber Glass Insulation

Dear Mr. Fernald,

CertainTeed Fiber Glass Insulation is a member of the U.S. Green Building Council and supports their efforts under the Leadership in Energy and Environmental Design (LEED) program.

→ The EPA Recovered Material Guideline now recommends a recycled content requirement for fiber glass of 20-25% consisting of post-industrial or post-consumer glass cullet. CertainTeed fiber glass insulations meet this requirement on a system-wide basis.

Our product may help contribute to the following LEED Categories:

- |                              |  |
|------------------------------|--|
| Energy & Atmosphere          | Prereq 2 - Minimum Energy Performance                    |
|                              | Credit 1 - Optimize Energy Performance                   |
| Materials & Resources        | Credit 4 - Recycled Content                              |
| Indoor Environmental Quality | Credit 7.1 - Thermal Comfort, Comply with ASHRAE 55-1992 |
| Innovation & Design Process  | Credit 1.1 - Innovation in Design                        |

In addition, our insulation meets the GREENGUARD™ standards for total particle and Volatile Organic Compound (VOC) emissions, including formaldehyde. Please see the attached certification letter.

I am also enclosing a copy of Insulation Facts # 45, a publication printed by the North American Insulation Manufacturer's Association, of which CertainTeed is a member, which details some ways the industry is working to help create a sustainable environment.

If you need any additional information please do not hesitate to call me.

Sincerely,

Randy Straight  
Manager, Residential Technical Services  
CertainTeed Corporation  
Office: (800) 274-8530 Ext. 6826  
Fax: (610) 254-5437  
Randall.K.Straight@smint-gobain.com

Room for WBRC's review stamp →

Specific product info clearly marked →

<input checked="" type="checkbox"/> Reviewed, No Exception Taken	<input type="checkbox"/> Reviewed, Revise As Noted
<input checked="" type="checkbox"/> Revise and Resubmit	<input type="checkbox"/> Rejected
<small>(Check mark designates action taken)</small> WBRC Architects Engineers 44 Central Street, Bangor, ME 04401	
See Section on "Submittals" of the specifications, and limitations of this review, and responsibility of the contractor. In no case are quantities guaranteed. Review is not to be construed as permitting omission of the specified details necessary or specified but not specifically detailed or mentioned on the reviewed drawings	
Date	By
2-5-05	<i>[Signature]</i>

Technical Services recommendations are for the information of the project designer. The project designer, engineer or architect is responsible for the suitability and performance of a design.

## 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 "Allowances" for testing and inspecting allowances.
  - 2. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
  - 3. Division 01 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
  - 4. Divisions 02 through 49 Sections for specific test and inspection requirements.

## 1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.

- D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.
- E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- J. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
  - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
- K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

#### 1.4 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

#### 1.5 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

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

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

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

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

## 1.6 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

- F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- G. 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.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
  2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  3. Demonstrate the proposed range of aesthetic effects and workmanship.
  4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.
  5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

6. Demolish and remove mockups when directed, unless otherwise indicated.

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

## 1.7 QUALITY CONTROL

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

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

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

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
  - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

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

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

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

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.



4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for commencement of the Work.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

## 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. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
  - 2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

## SECTION 014200 - REFERENCES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
- J. Substantial Completion: Refer to Section 3-A Standard General Conditions.

## 1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
  - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."
- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl2

BOCA	BOCA International, Inc. (See ICC)	
IBC	International Building Code	
ICBO	International Conference of Building Officials (See ICC)	
ICC	International Code Council www.iccsafe.org	(888) 422-7233 (703) 931-4533
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
UBC	Uniform Building Code (See ICC)	

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

PRIVATE tbl3

EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
USDA	Department of Agriculture www.usda.gov	(202) 720-2791

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

PRIVATE tbl4

ADAAG	Americans with Disabilities Act (ADA)	(800) 872-2253
	Architectural Barriers Act (ABA)	(202) 272-0080
	Accessibility Guidelines for Buildings and Facilities	
	Available from Access Board	
	<a href="http://www.access-board.gov">www.access-board.gov</a>	

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

PRIVATE tbl5

BGS	State of Maine Bureau of General Services
DOE	State of Maine Department of Education
MDEP	State of Maine Department of Environmental Protection
MDOT	State of Maine Department of Transportation
	Maine State Plumbing Code

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

## SECTION 014400 - CONSTRUCTION INDOOR AIR QUALITY

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. IAQ Management Goals.
- B. IAQ Management Plan.
- C. IAQ Management Plan Implementation.

## 1.2 IAQ MANAGEMENT GOALS

- A. The Government has established that this Project shall prevent indoor air quality problems resulting from the construction process, to sustain long term installer and occupant health and comfort.
- B. Protect the ventilation system components during construction and cleanup of contaminated components after construction is complete.
- C. Control sources of potential IAQ pollutants by controlling selection of materials and processes used in project construction.
- D. With regard to these goals the Contractor shall develop, for Government and Architect's review, an IAQ Management Plan for this Project.

## 1.3 SUBMITTALS

- A. Construction IAQ Management Plan highlighting the five requirements of the SMACNA IAQ Guideline for Occupied Buildings under Construction, 1995, Chapter 3 "Control Measures".
- B. Photographs documenting construction IAQ management measures implemented during construction such as duct protection measures and measures to protect on-site stored or installed absorptive materials from moisture.
- C. Cut sheets of filtration media used during construction and installed immediately prior to occupancy with MERV values highlighted
- D. Submit a letter from the Contractor describing building flushout procedures including actual dates of building flushout.

## PART 2 - PRODUCTS

## 2.1 IAQ MANAGEMENT PLAN

- A. Develop a Draft Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the building as follows: (1) during construction meet or exceed the minimum requirements of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction 1995, Chapter 3, (2) Protect stored on-site or installed absorptive materials from moisture damage, and (3) conduct a minimum two-week building flushout after construction ends and prior to occupancy.
1. The SMACNA IAQ Guidelines for Occupied Buildings under Construction provides an overview of air pollution associated with construction, control measures, construction process management, quality control, communicating with occupants, and case studies. These guidelines can be accessed at [www.smacna.org](http://www.smacna.org). Chapter 3 of the SMACNA Guidelines recommends Control Measures in five areas: HVAC protection, source control, pathway interruption, housekeeping, and scheduling. Review the applicability of each Control Measure and include those that apply in the Draft IAQ Management Plan.
    - a. HVAC Protection: Shut down the return side of the HVAC system whenever possible during heavy construction. If the system must remain operational during construction include the following strategies that apply:
      - 1) Fit the return side of the HVAC system with temporary filters of MERV 8 or better.
      - 2) Isolate the return side of the HVAC system from the surrounding environment as much as possible (e.g., place all tiles for the ceiling plenum, repair all ducts and air handler leaks).
      - 3) Damper off the return system in the heaviest work areas and seal the return system openings with plastic.
      - 4) Upgrade the filter efficiency where major loading is expected to affect operating HVAC system.
      - 5) Clean permanent return air ductwork per National Air Duct Cleaning Association standards upon completion of all construction and finish installation work.
      - 6) Install new clean media just prior to substantial completion and occupancy that has a Minimum Efficiency Reporting Value (MERV) of 13 as determined by ASHRAE 52.2-1999.
    - b. Source Control: Propose the substitution of non-toxic formulations of materials that are generally the responsibility of the contractor such as caulks, sealants, and cleaning products.
    - c. Pathway Interruption: Prevent contamination of clean spaces. Include the following strategies that apply:
      - 1) Use 100% outside air ventilation (when outside temperatures are between 55 degrees F and 85 degrees F and humidity is between 30% and 60%) with air exhausted directly to the outside during installation of finishes and other VOC emitting materials.
      - 2) Erect some type of barrier between work areas or between the inside and outside of the building to prevent unwanted airflow from dirty to clean areas
    - d. Housekeeping: Reduce construction contamination in the building prior to occupancy through HVAC and regular space cleaning activities.
      - 1) Store building materials in a weather tight, clean area prior to unpackaging for installation.

- 2) Check for possible damage to the HVAC and Building system from high humidity.
  - 3) Clean all coils, air filters, and fans before testing and balancing procedures are performed.
- e. Scheduling: Specify construction sequencing to reduce absorption of VOC's by materials that act as sinks or contaminant sources. Complete application of wet and odor-emitting materials such as paints, sealants, and coatings before installing sink materials such as ceiling tiles, carpets, insulation, gypsum products, and fabric-covered furnishings are installed.
2. Protect stored on-site or installed absorptive materials from exposure to moisture through precipitation, plumbing leaks, or condensation from the HVAC system to prevent microbial contamination.
  3. As part of Indoor air quality management, one of the following requirements has to be met:
    - a. Building Flush Out, Option 1: Just prior to Substantial Completion with all interior finishes installed, flush out building by supplying a minimum of 396 424 L (14,000 cu.ft) of outdoor air per sq. m (sq.ft) of floor area while maintaining an internal temperature of at least 16 deg C (60 deg F) and a relative humidity no higher than 60%.

OR

- b. Building Flush Out, Option 2: if occupancy is desired prior to completion of the flush-out, the space may be occupied following delivery of a minimum of 99 109 L (3500 cu.ft) of outdoor air per sq. m (sq.ft) of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm/sq. ft. of outside air of the design minimum outside air rate determined in EQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 396 424 L (14,000 cu.ft) of outside air has been delivered to the space.

OR

- c. Conduct baseline IAQ testing, after construction ends and prior to occupancy, using testing protocols consistent with the United States Environmental Protection Agency Compendium of Methods for the Determination of Air Pollutants in Indoor Air and as additionally detailed in the LEED for Schools Reference Guide. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
  - 1) Formaldehyde: 50 part per billion.
  - 2) Particulates (PM10): 50 micrograms per cubic meter.
  - 3) Total Volatile Organic Compounds (TVOC): 500 micrograms per cubic meter.
  - 4) \* 4-Phenylcyclohexene (4-PCH): 6.5 micrograms per cubic meter.
  - 5) Carbon Dioxide: 9 parts per million and no greater than 2 parts per million above outdoor levels.

\* This test is only required if carpets and fabrics with styrene butadiene rubber (SBR) latex backing materials are installed as part of the base building systems.

- B. Draft IAQ Management Plan Review Meeting: Once the Site Representative and Architect have reviewed the Draft IAQ Management Plan and prior to construction at the site, schedule and conduct a meeting to review the Draft IAQ Management Plan and discuss procedures, schedules and specific requirements for IAQ during the construction and pre-construction phases of the building. Discuss coordination and interface between the Contractor and other construction activities. Identify and resolve problems with compliance to the requirements. Record minutes of the meeting, identify all conclusions reached and matters requiring further resolution.



1. Attendees: The Contractor and related Contractor personnel associated with the work of this section, including personnel to be in charge of the IAQ management program, Architect, Owner and such additional personnel as the Architect or Owner deems appropriate.
  
- C. Final IAQ Management Plan: Make any revisions to the Draft IAQ Management Plan agreed upon during the meeting identified in item (B) above and incorporate resolutions agreed to be made subsequent to the meeting. Submit the revised plan to the Owner and Architect for approval within 10 calendar days of the meeting.

### PART 3 - EXECUTION

#### 3.1 IMPLEMENTATION OF IAQ MANAGEMENT PLAN

- A. Manager: The Contractor shall designate an on-site party (or parties) responsible for instructing workers and overseeing and the IAQ Management Plan for the Project.
  
- B. Progress Meetings: Construction related IAQ procedures shall be included in the pre-construction and construction progress meeting agendas.
  
- C. Distribution: The Contractor shall distribute copies of the IAQ Management Plan to the Job Site Foreman, each Subcontractor, the Site Representative, and the Architect.
  
- D. Instruction: The Contractor shall provide on-site instruction of the IAQ procedures and ensure that all participants in the construction process understand the importance of the goals of the IAQ Management Plan.

END OF SECTION 01 44 00

## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections include the following:
  - 1. Division 01 Section "Summary" for limitations on utility interruptions and other work restrictions.
  - 2. Division 01 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
  - 3. Division 01 Section "Execution" for progress cleaning requirements.
  - 4. Divisions 02 through 49 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.
  - 5. Division 31 Section "Dewatering" for disposal of ground water at Project site.

## 1.3 DEFINITIONS

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

## 1.4 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Pay sewer service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.
- E. Heating Fuel: Fuel required for temporary heating will be the responsibility of the Contractor.
- F. Telephone/Fax Service: Pay service and use charges for telephone or data cable usage, by Contractor, at Project site.

### 1.5 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements to protect install concrete and masonry.

### 1.6 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

### 1.7 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
- B. Frost Protection: Protect footings from freezing temperatures and prevent frost from occurring beneath footings. Frozen water found on soil or concrete surface shall be reason for rejection of protection method. Provide corrective measures within 24 hours after notice of condition is given. Evidence of frost at these locations shall be reason for rejection, removal, and replacement at no additional cost to the Owner.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Portable Chain-Link Fencing: Minimum 2-inch, 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide concrete or galvanized steel bases for supporting posts.
- B. Lumber and Plywood: Comply with requirements in Division 06 Section "Rough Carpentry."
- C. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36/C 36M.
- D. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
- E. Paint: Comply with requirements in Division 09 painting Sections.

## 2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel. Keep office clean and orderly. Furnish and equip offices as follows:
  - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
  - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack board.
  - 3. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
  - 4. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- C. Clerk of Work Field Office: Provide an insulated, weathertight, heated, and air-conditioned field office for use by the Clerk of Works. Provide single unit of at least 10' x 20' with two separate office spaces and demising wall with door
  - 1. Duration:
    - a. Within 2 weeks of notice of award of contract until project completion.
  - 2. Furnish and equip each of the two offices as follows:
    - a. Desk and two chairs, four-drawer file cabinet, a plan table, a plan rack, and bookcase.
    - b. Provide each office with separate phone, fax, and answering machine.
  - 3. Provide an electric heater with thermostat capable of maintaining a uniform indoor temperature of 68 deg F. Provide an air-conditioning unit capable of maintaining an indoor temperature of 72 deg F.
  - 4. Provide fluorescent light fixtures capable of maintaining average illumination of 20 fc at desk height. Provide 110- to 120-V duplex outlets spaced at not more than 12-foot intervals, 1 per wall in each room.
- D. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
  - 1. Store combustible materials apart from building.

## 2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control. Vent all heating units to the outside of the building.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited. Babfar heating units located outside the building will be acceptable.

2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
  1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

#### 3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
  1. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- D. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
  1. Maintain a minimum temperature of 50 deg F in permanently enclosed portions of building for normal construction activities, and 65 deg F for finishing activities and areas where finished Work has been installed.
    - a. Refer to Divisions 2 through 16 for additional temporary heat, ventilation, and humidity requirements for products in those Sections."
  2. Provide temporary heat to protect all concrete work during installation as well as other trades needing specific heat requirements to perform and protect their work. See individual specification sections for detailed information.
  3. All concrete slabs on grade, footings and foundations not below the frost line shall be protected from freezing either by heating or protecting with insulation until substantial completion.

4. Permanent air heating systems may be used to provide heat only when finishes are complete enough to eliminate construction dust and with the prior approval of the Architect and Owner. Pay for operating costs resulting from the use of the permanent heating system prior to "substantial completion" unless otherwise agreed to by the Owner. Extend warranty periods for such systems at the Contractor's expense so that the Owner gets the fully intended warranty period effective the day of "Substantial Completion".
  5. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and replacement of filters and worn or consumed parts.
- E. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
1. It shall be the General Contractor's responsibility to provide dehumidifiers or humidifiers required to perform the installation of wood floors.
- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
1. Install electric power service overhead, unless otherwise indicated.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install separate telephone lines for each field office.
1. Provide additional telephone lines for the following:
    - a. Provide a dedicated telephone line for each facsimile machine and computer in each field office.
    - b. Provide phone/answering/facsimile machine and separate telephone service accounts for two separate lines for the sole use of the Architect Field Representative.
      - 1) Contractor will arrange for installation and installation charges. Monthly phone charges will be paid by the Contractor.
  2. At each telephone, post a list of important telephone numbers.
    - a. Police and fire departments.
    - b. Ambulance service.
    - c. Contractor's home office.
    - d. Architect's office.
    - e. Engineers' offices.
    - f. Owner's office.
    - g. Principal subcontractors' field and home offices.
  3. Provide an answering machine on superintendent's telephone.

- I. Electronic Communication Service: Provide DSL to Contractor and Clerk-of-the-Works field offices.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:

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

- B. Temporary Roads and Parking Areas: Construct and maintain temporary roads and parking areas adequate to support loads and to withstand exposure to traffic during construction period. Locate temporary roads and parking areas within construction limits indicated on Drawings.

1. Provide a reasonably level, graded, well-drained subgrade of satisfactory soil material, compacted to not less than 95 percent of maximum dry density in the top 6 inches.
2. Provide gravel paving course of subbase material not less than 3 inches thick; roller compacted to a level, smooth, dense surface.
3. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

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

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

- D. Parking: Provide temporary parking areas for construction personnel.

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

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

- F. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.

1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated. Include name of project, and names of Owner, Architect and Contractor. Comply with details indicated on the sketch attached to the end of this section.
2. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in size of 4 by 8 feet and 3/4 inch thickness, unless otherwise indicated. Support on posts or framing of preservative-treated wood or steel.
3. Provide magnetic signs to be attached to the office trailers. Comply with details indicated on the sketch attached to the end of this section.
4. Prepare temporary signs to provide directional information to construction personnel and visitors.
5. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.
6. Provide temporary, directional signs for construction personnel and visitors.
7. Maintain and touchup signs so they are legible at all times.

- G. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
  - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

### 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
  - 1. Comply with work restrictions specified in Division 01 Section "Summary."
- B. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Division 31 Section "Site Clearing."
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- E. Site Enclosure Fence: Before construction operations begin, furnish and install 6 foot chain link site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
  - 1. Extent of Fence: As indicated on Drawings.
- F. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- I. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
  - 1. Prohibit smoking in construction areas.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

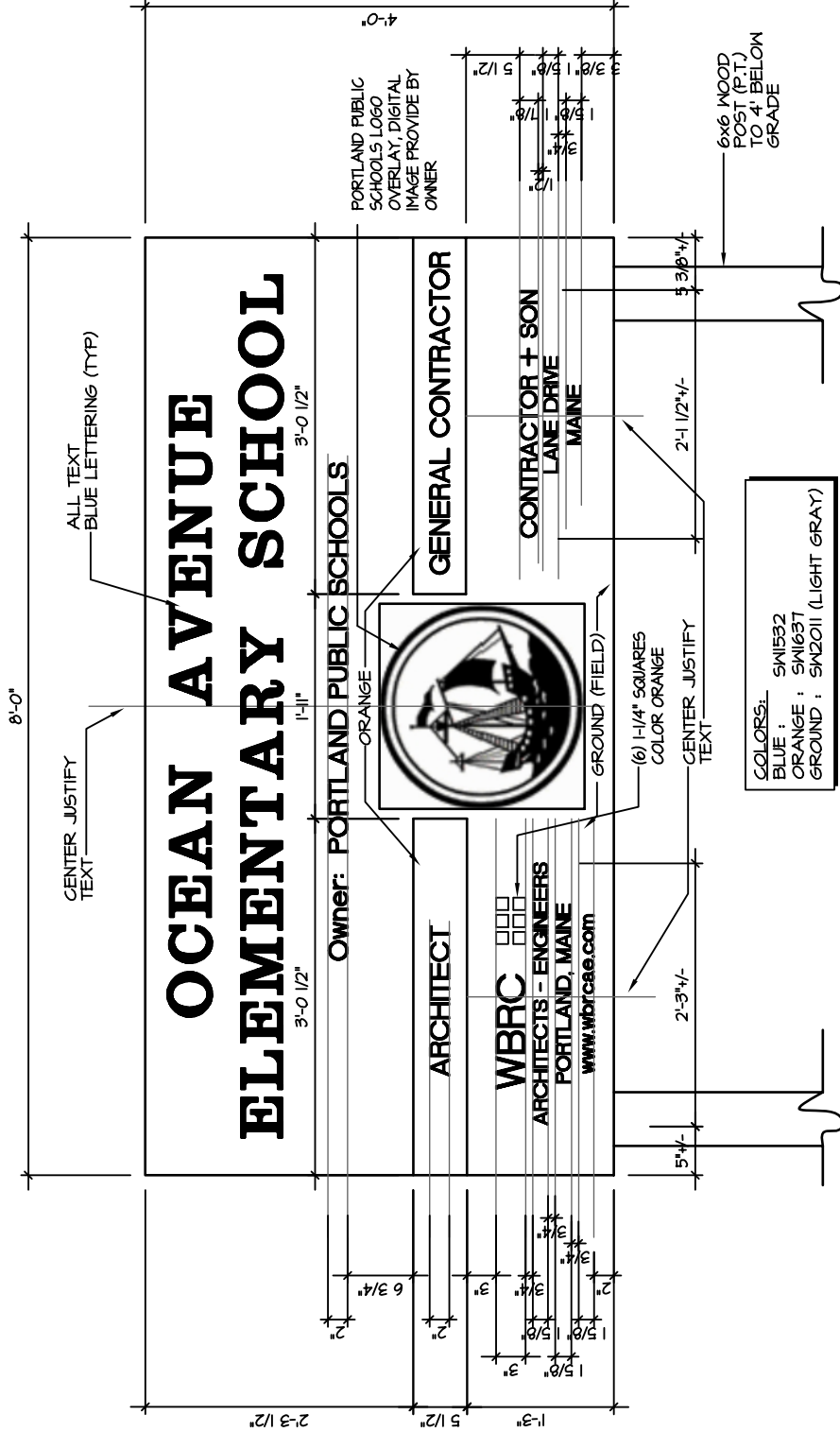


3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide hoses for fire protection of sufficient length to reach construction areas. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

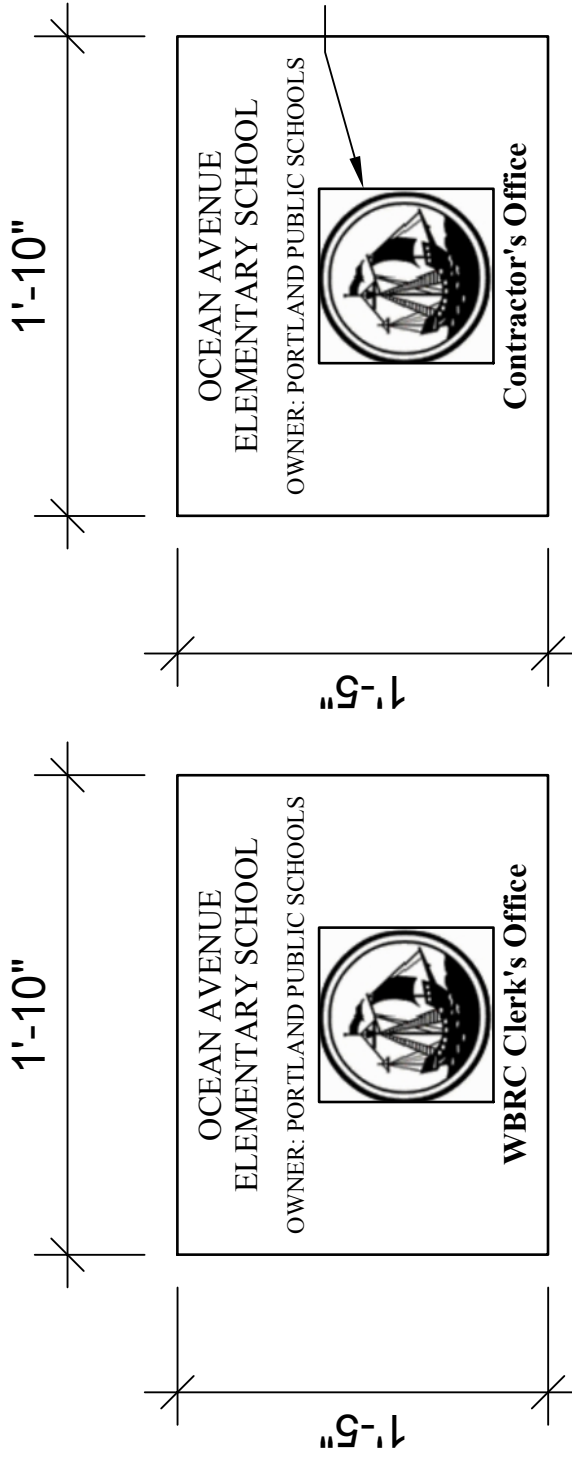
### 3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  2. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
  3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000



**PROJECT SIGN**  
N.T.S.



PORTLAND  
PUBLIC  
SCHOOLS  
LOGO  
OVERLAY,  
DIGITAL  
IMAGE  
PROVIDE BY  
OWNER

PROVIDE ONE EACH OF THESE FULL  
MAGNETIC BACKED VINYL SIGNS. LETTERING  
AND GRAPHICS SIMILAR TO PROJECT SIGN  
OF CUT VINYL LETTER OVERLAY.

# JOB TRAILLER MAGNET SIGNS

N.T.S.

## SECTION 016000 - PRODUCT REQUIREMENTS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
  - 1. Division 01 Section "Allowances" for products selected under an allowance.
  - 2. Division 01 Section "Alternates" for products selected under an alternate.
  - 3. Division 01 Section "References" for applicable industry standards for products specified.
  - 4. Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
  - 5. Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

## 1.3 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

#### 1.4 ACTION SUBMITTALS

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

#### 1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
  - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
  - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- B. Products with asbestos: Asbestos containing materials are not to be purchased or installed in this project.

#### 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
- C. Storage:
  - 1. Store products to allow for inspection and measurement of quantity or counting of units.
  - 2. Store materials in a manner that will not endanger Project structure.
  - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
  - 4. Store cementitious products and materials on elevated platforms.
  - 5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
  - 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  - 7. Protect stored products from damage and liquids from freezing.
  - 8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

## 1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  - 1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  - 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
  - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
  - 3. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. LEED Considerations: Where possible, consider selecting products that are outlined in Division 01 Section "Sustainable Design Requirements" and elsewhere within the Project Manual.
- B. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
  - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  - 4. Where products are accompanied by the term "as selected," Architect will make selection.
  - 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
  - 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
  - 7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved substitute" or approved," comply with provisions in "Product Substitutions" Article to obtain approval for use of an unnamed product.
- C. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Substitutions for Contractor's convenience will not be considered.
  2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Substitutions for Contractor's convenience will not be considered.
  3. Products:
    - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Substitutions for Contractor's convenience will be considered, unless otherwise indicated.
    - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in Division 01 Section "Substitution Procedures" for consideration of an unnamed product.
  4. Manufacturers:
    - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered, unless otherwise indicated.
    - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in Division 01 Section "Substitution Procedures" for consideration of an unnamed manufacturer.
  5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in Division 01 Section "Substitution Procedures" for consideration of an unnamed product or manufacturer.
- D. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "Substitution Procedures" for proposal of product.
- E. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

## SECTION 017300 - EXECUTION

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

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

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

- B. Related Sections include the following:

1. Division 01 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 01 Section "Submittal Procedures" for submitting surveys.
3. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
4. Division 01 Section "Construction Waste Management and Disposal" for additional requirements for progress cleaning.
5. Division 01 Section "General Commissioning Requirements."

## 1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

## 1.4 INFORMATIONAL SUBMITTALS

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



- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- D. Certified Surveys: Submit two copies signed by land surveyor.
- E. Final Property Survey: Submit 6 copies showing the Work performed and record survey data.

#### 1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
  - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from the Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
  - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
  - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
  - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

#### 1.6 WARRANTY

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

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
  - 1. For projects requiring compliance with sustainable design and construction practices and procedures, utilize products for patching that comply with requirements of Division 01 Section "Sustainable Design Requirements."

- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to the Architect for the visual and functional performance of in-place materials.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
  - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
    - a. Description of the Work.
    - b. List of detrimental conditions, including substrates.
    - c. List of unacceptable installation tolerances.
    - d. Recommended corrections.
  - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  - 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

#### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other

construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information (RFI) to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
  - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  - 3. Inform installers of lines and levels to which they must comply.
  - 4. Check the location, level and plumb, of every major element as the Work progresses.
  - 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
  - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

### 3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
  2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

### 3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
  2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
  4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Temporary Support: Provide temporary support of work to be cut.
- C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements of Division 01 Section "Summary."
- E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  6. Proceed with patching after construction operations requiring cutting are complete.
- G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### 3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
  2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. For general construction, each trade shall pick up the debris and rubbish, generated by that trade, and dispose of in dumpsters furnished by the General Contractor.
- E. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- F. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- G. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

### 3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

- C. Protect resilient flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.
  - 1. Cover products installed on floor surfaces with undyed, untreated building paper until inspection for Substantial Completion.
  - 2. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.
  
- D. Protect roofing materials against cuts, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period.
  - 1. Cover roofing products with plywood or suitable protection cover until inspection for Substantial Completion.
  - 2. Do not move heavy and sharp objects directly over roof surfaces. Place plywood or hardboard panels over roofing and under objects while they are being moved. Slide or roll objects over panels without moving panels.

### 3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
  
- B. Restore permanent facilities used during construction to their specified condition.
  
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
  
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
  
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300



## SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

## 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 administrative and procedural requirements for the following:
  - 1. Recycling nonhazardous construction waste.
  - 2. Disposing of nonhazardous construction waste.
- B. Related Sections include the following:
  - 1. Division 01 Section "Temporary Facilities and Controls" for environmental-protection measures during construction, and location of waste containers at Project site.
  - 2. Division 04 Section "Unit Masonry" for disposal requirements for masonry waste.
  - 3. Division 31 Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

## 1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

## 1.4 PERFORMANCE REQUIREMENTS

- A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling a minimum of 75 percent by weight of total waste generated by the Work.

- B. Salvage/Recycle Requirements: Owner's goal is to salvage and recycle as much nonhazardous construction waste as possible including the following materials:
1. Construction Waste:
    - a. Site-clearing waste.
    - b. Masonry and CMU.
    - c. Lumber.
    - d. Wood sheet materials.
    - e. Wood trim.
    - f. Metals.
    - g. Roofing.
    - h. Insulation.
    - i. Carpet and pad.
    - j. Piping.
    - k. Electrical conduit.
    - l. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
      - 1) Paper.
      - 2) Cardboard.
      - 3) Boxes.
      - 4) Plastic sheet and film.
      - 5) Polystyrene packaging.
      - 6) Wood crates.
      - 7) Plastic pails.

#### 1.5 SUBMITTALS

- A. Waste Management Plan: Submit 3 copies of plan within 30 days of date established for commencement of the Work.
- B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit three copies of report. Include the following information:
1. Material category.
  2. Generation point of waste.
  3. Total quantity of waste in tons.
  4. Quantity of waste recycled, both estimated and actual in tons.
  5. Total quantity of waste recovered (salvaged plus recycled) in tons.
  6. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- C. Waste Reduction Calculations: Before request for Substantial Completion, submit three copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- D. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- E. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

- F. LEED Submittal: LEED letter template for Credit MR 2.1 and 2.2, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.
- G. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

#### 1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
  - 1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
  - 2. Review requirements for documenting quantities of each type of waste and its disposition.
  - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
  - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
  - 5. Review waste management requirements for each trade.

#### 1.7 WASTE MANAGEMENT PLAN

- A. General: Develop plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
  - 1. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
  - 2. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
  - 3. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.
- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from recycled materials.
5. Savings in hauling and tipping fees that are avoided.
6. Handling and transportation costs. Include cost of collection containers for each type of waste.
7. Net additional cost or net savings from waste management plan.

E. Forms: Prepare waste management plan on forms similar to those included at end of Part 3.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 PLAN IMPLEMENTATION

- A. General: Implement waste management plan as approved by Architect. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project. Coordinator may be the Project Superintendent.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
1. Distribute waste management plan to everyone concerned within three days of submittal return.
  2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Designate and label specific areas on Project site necessary for separating materials that are to be recycled, reused, donated, and sold.
  2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

### 3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Receivers and Processors: List below is provided for information only; available recycling receivers and processors include, but are not limited to, the following:
1. Almighty Waste (207-782-4000) and division of ERRCO, Epping NH (603-679-2626).

2. Pike Industries in Augusta, ME (207-782-2411) will recycle asphalt paving.
  3. Cousineau Bark & Wood, Wilton, ME will chip clean dimensional lumber (without nails or paint).
  4. Boralex, Inc., Livermore Falls, ME will recycle OSB, plywood and particleboard (no pressure treated materials)
  5. Sandy River Waste, Route 2, Farmington, ME (207-778-3254) will recycle paper, cardboard, cans, bottles, some plastics.
  6. Grimmel Industries, Topsham, ME (207-729-2191) will recycle metals.
- C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
    - a. Inspect containers and bins for contamination and remove contaminated materials if found.
  2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
  4. Store components off the ground and protect from the weather.
  5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

### 3.3 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
  2. Polystyrene Packaging: Separate and bag materials.
  3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
  4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Site-Clearing Wastes: Chip brush, branches, and trees on-site or at landfill facility.
1. Comply with requirements in Division 32 Section "Plants" for use of chipped organic waste as organic mulch.
- C. Wood Materials:
1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
  2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
    - a. Comply with requirements in Division 32 Section "Plants." for use of clean sawdust as organic mulch.

3.4 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 017419

(SAMPLE)  
**CONSTRUCTION WASTE MANAGEMENT PLAN**

**Company Name:**

**Contact Person:**

**Telephone #:**

**Address:**

**Project Location:**

**Contractor:**

**Architect:**

**Contact Person:**

**Contact Person:**

**Telephone #:**

**Telephone #:**

**Recycling Coordinators:**

**Designated Recycling Coordinators:**

**Project Description:**

**Waste Management Goals:**

- Ø This project will recycle or salvage for reuse a minimum of **50%** by weight of the waste generated on-site.
- Ø Waste reduction will be achieved through building design, and reuse and recycling efforts will be maintained throughout the construction process.

**Waste Prevention Planning:**

- Ø Compliance with \_\_\_\_\_ (name of recycling company) \_\_\_\_\_ recycling requirements for businesses. Recyclables include:
  - newspaper
  - corrugated cardboard
  - white and colored office paper
  - glass bottles and jars
  - metal cans
- Ø Compliance with \_\_\_\_\_ (name of recycling company) \_\_\_\_\_ bans, i.e. no disposal of tires, appliances, yard waste, mandatory recyclables, hazardous waste, batteries, fluorescent tubes, and large metal items.
- Ø Project Construction Documents – Requirements for waste management which will be included in all work. The General Contractor will contractually require all subcontractors to comply with the \_\_\_\_\_ (name of recycling company) \_\_\_\_\_ recycling requirements. A copy of this Construction Waste Management Plan will accompany all Subcontractor Agreements and require subcontractor participation.
- Ø The Construction Waste Reduction Plan shall be implemented and executed as follows and as on the chart:
  - Salvageable materials will be diverted from disposal where feasible.
  - There will be a designated area on the construction site reserved for a row of dumpsters each specifically labeled for respective materials to be received.

- Before proceeding with any removal of construction materials from the construction site, Recycling Coordinators will inspect containers for compliance with \_\_\_\_\_ (name of recycling company) \_\_\_\_\_ requirements.
- Wood cutting will occur in centralized locations to maximize reuse and make collection easier.
- Hazardous waste will be managed by a licensed hazardous waste vendor.

**Communication & Education Plan:**

- Ø The General Contractor will conduct an on-site pre-construction meeting with subcontractors. Attendance will be required for the subcontractor's key field personnel. The purpose of the meeting is to reinforce to subcontractor's key field employees the commitments made by their companies with regard to the project goals and requirements.
- Ø Waste prevention and recycling activities will be discussed at the beginning of each weekly subcontractor coordination meeting to reinforce project goals and communicate progress to date.
- Ø As each new subcontractor comes on site, the recycling coordinators will present him/her with a copy of the Waste Management Plan and provide a tour of the recycling areas.
- Ø The subcontractor will be expected to make sure all their crews comply with the Waste Management Plan.
- Ø All recycling containers will be clearly labeled. Containers shall be located in close proximity to the building(s) under construction in which recyclables/salvageable materials will be placed.
- Ø Lists of acceptable/unacceptable materials will be posted throughout the site.
- Ø All subcontractors will be informed in writing of the importance of non-contamination with other materials or trash.
- Ø Recycling coordinators shall inspect the containers on a weekly basis to insure that no contamination is occurring and precautions shall also be taken to deter any contamination by the public.

**Motivation Plan:**

- Ø The project team will develop and publish a project mission statement that can be distributed to the subcontractors, attached to subcontracts, and posted at the jobsite.
- Ø The General Contractor will conduct a pre-award meeting for subcontractors. Subcontractors under consideration will be required to attend the meeting to review project goals and requirements with the project team. Attendance will be a prerequisite for award of subcontracts. A sign-off will be required by subcontractors attending the meeting that the project goals are understood. This document will be an attachment to every subcontract. Copies of the attachment will be posted prominently at the jobsite.

**Evaluation Plan:**

- Ø The General Contractor will develop, update, and post at the jobsite a graph indicating the progress to date for achieving the project's waste recycling goal of XX% by weight of the total project waste stream.

**Expected Project Waste, Disposal, and Handling:**



The following charts identify waste materials expected on this project, their disposal method, and handling procedures:

Material	Quantity	Disposal Method	Handling Procedure
Land clearing debris		Keep separate for reuse and or wood sale	Keep separated in designated areas on site.
Clean dimensional wood and palette wood		Keep separate for reuse by on-site construction or by site employees for either heating stoves or reuse in home projects. Recycle at: _____	Keep separated in designated areas on site. Place in "Clean Wood" container.
Plywood, OSB, particle board		Reuse, landfill	Keep separated in designated areas on site. Place in "Trash" container.
Painted or treated wood		Reuse, landfill	Keep separated in designated areas on site. Place in "Trash" container.
Concrete		Recycle	
Concrete Masonry Units		Keep separate for re-use by on-site construction or by site employees	Keep separated in designated areas on site
Metals		Recycle at: Williston Drop Off Center	Keep separated in designated areas on site. Place in "Metals" container.
Paint		Reuse or recycle at _____	Keep separated in designated areas on site
Insulation		Reuse, landfill	
Flooring		Reuse, landfill	
Carpet and pad		Reuse or recycle with carpet manufacturer	
Glass		Glass Bottles: Recycle at: _____	Keep separated in designated areas on site. Place in "Glass/Plastic bottles/Metal Cans/Mixed Paper/Cardboard" container
Plastics		Plastic Bottles: Recycle at: _____  Plastic bags/scrap: Reuse, landfill	Keep separated in designated areas on site. Place in "Glass/Plastic bottles/Metal Cans/Mixed Paper/Cardboard" container
Beverage		Recycle at: _____	Keep separated in designated areas on site. Place in "Glass/Plastic bottles/Metal Cans/Mixed Paper/

Material	Quantity	Disposal Method	Handling Procedure
Cardboard		Recycle at: _____	Cardboard" container Keep separated in designated areas on site. Place in "Glass/Plastic bottles/Metal Cans/Mixed Paper/ Cardboard" container
Paper and newsprint		Recycle at: _____	Keep separated in designated areas on site. Place in "Glass/Plastic bottles/Metal Cans/Mixed Paper/ Cardboard" container
<b>TOTAL</b>			

**Waste Disposal:** Contractor:  
Contact:

- Ø **Name of landfill for disposal of non-recyclable waste:**
  - Transfer Stations:
  - Landfills (ultimate disposal location):
- Ø **Landfill tipping fee:**     \$XX / ton
- Ø **Estimate of waste for landfill disposal:**

**Recycling Calculation:**

**If all construction waste was disposed in landfill:** XX lbs = XX tons x \$XX/ton = **\$XX**

**With recycling:**   TOTAL =           **\$XX**

**RECYCLING OPERATIONS**

Action ***	Who	When
Choose bins/collection methods		_____
Order bins - oversee deliver		_____
Site bins/collection sites for optimum convenience		_____
Sort or process wood		_____
Sort or process metal		_____
Sort or process cardboard		_____
Sort or process _____ (material)		_____
Schedule material pickups/dropoffs		_____
Protect Materials from Contamination		_____
Document material pickups/dropoffs		_____

\*\*\* Depending on the service option chosen, these may be the responsibility of either the field personnel, the hauler, a full-service recycling contractor, or the subcontractors.

**COMMUNICATION PLAN - Except for mandatory items (\*), check other items intended to be used.**

Action	Who	When	Completed
Complete Construction Waste Mgmt. Plan*	_____		
Hold Orientation/Kick-off Meeting*	_____		
Update & Progress in Weekly Job-Site Meetings*	_____		
Encourage Just-In-Time Deliveries	_____		
Post Targeted Materials (Signage)	_____		
Distribute Tip Sheets for Job-Site Personnel	_____		
Post Goals/Progress (Signage)	_____		
_____	_____		

**MOTIVATION PLAN - Except for mandatory items (\*), check other items intended to be used.**

Action	Who	When	Completed
Use formal agreements committing Subs to program	_____		
Require Mis-Sorters to Re-Sort Bin	_____		
Provide Stickers, T-Shirts, or Hats	_____		
Public Recognition of Participating Subs	_____		
Letters of Recognition	_____		
Awards Luncheon	_____		
_____	_____		

**EVALUATION PLAN - Except for mandatory items (\*), check other items intended to be used.**

Action	Who	When	Completed
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Perform Short Form Waste Audit

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Perform Full Waste Audit

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Perform Mid-Course Assessment

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Perform Monthly Cost and Materials Tracking\*

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Perform Final Evaluation\*

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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" 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 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
  - 6. Division 01 Section "General Commissioning Requirements."
  - 7. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

## 1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
  - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  - 2. Advise Owner of pending insurance changeover requirements.
  - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
    - a. Full Payment Retainage may be held until final submittal of these documents has been submitted and approved.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
  7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  8. Complete startup testing of systems.
  9. Submit test/adjust/balance records.
  10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  11. Advise Owner of changeover in heat and other utilities.
  12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
  13. Complete final cleaning requirements, including touchup painting.
  14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for Final Completion.

#### 1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
  2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.

2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
  - a. Project name.
  - b. Date.
  - c. Name of Architect.
  - d. Name of Contractor.
  - e. Page number.

## 1.6 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
  1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

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

## PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
  1. VOC Content: Provide cleaning products with VOC content of not more than 150 g/L.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.



1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
  - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
  - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
  - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
  - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
  - e. Remove snow and ice to provide safe access to building.
  - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
  - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
  - h. Sweep concrete floors broom clean in unoccupied spaces.
  - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
  - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - k. Remove labels that are not permanent.
  - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
  - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - n. Replace parts subject to unusual operating conditions.
  - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - q. Clean ducts, blowers, and coils if units were operated without filters during construction.
  - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
  - s. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

## SECTION 017823 - OPERATION AND MAINTENANCE DATA

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 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 49 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 2 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 one copy of draft and mark whether general scope and content of manual are acceptable.
  - 1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

## 1.5 COORDINATION

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

## PART 2 - PRODUCTS

### 2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
  - 1. List of documents.
  - 2. List of systems.
  - 3. List of equipment.
  - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

### 2.2 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name, address, and telephone number of Contractor.

6. Name and address of Architect.
  7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
  2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
  4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
  5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

## 2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions.

2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

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

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

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

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

## 2.4 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

- C. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

## 2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - 1. Standard printed maintenance instructions and bulletins.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.
  - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.

3. Precautions against improper maintenance.
  4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  5. Aligning, adjusting, and checking instructions.
  6. Demonstration and training videotape, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

## PART 3 - EXECUTION

### 3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. 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.
- D. 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.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
1. Do not use original Project Record Documents as part of operation and maintenance manuals.
  2. Comply with requirements of newly prepared Record Drawings in Division 01 Section "Project Record Documents."
- F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823



## 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.
- 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 49 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 one set of marked-up Record Prints.
- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one copy of each Product Data submittal.
  - 1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.
- D. Full Payment Retainage may be held until final submittal of these documents has been submitted and approved.

## PART 2 - PRODUCTS

## 2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an understandable drawing technique.
    - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
  2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations below first floor.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made following Architect's written orders.
    - k. Details not on the original Contract Drawings.
    - l. Field records for variable and concealed conditions.
    - m. 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 bid item 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 and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.

- e. Name of Contractor.

## 2.2 RECORD SPECIFICATIONS

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

## 2.3 RECORD PRODUCT DATA

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

## 2.4 MISCELLANEOUS RECORD SUBMITTALS

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

## PART 3 - EXECUTION

### 3.1 RECORDING AND MAINTENANCE

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

## 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.
  - 3. Demonstration and training DVD's.
- B. Related Sections include the following:
  - 1. Divisions 02 through 49 Sections for specific requirements for demonstration and training for products in those Sections.

## 1.3 SUBMITTALS

- A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. At completion of training, submit one complete training manual for Owner's use.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.
- C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.
- D. Demonstration and Training DVD's: Submit two copies within seven days of end of each training module.
  - 1. Identification: On each copy, provide an applied label with the following information:
    - a. Name of Project.
    - b. Name and address of photographer.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Date DVD was recorded.
    - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

2. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding DVD. Include name of Project and date of DVD on each page.

#### 1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

#### 1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

### PART 2 - PRODUCTS

#### 2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
  1. Green roofing system.
  2. Motorized doors, including overhead coiling doors overhead coiling grilles and automatic entrance doors.
  3. Equipment, including food-service equipment.
  4. Fire-protection systems, including fire alarm, fire pumps, and fire-extinguishing systems.
  5. Intrusion detection systems.
  6. Heat generation, including boilers, pumps, and water distribution piping.
  7. Solar thermal system.
  8. Refrigeration systems, including condensers, pumps, and distribution piping.
  9. HVAC systems, including air-handling equipment, air distribution systems, and terminal equipment and devices.
  10. HVAC instrumentation and controls.
  11. Electrical service and distribution, including transformers, switchboards, panelboards, and motor controls.
  12. Packaged engine generators, including transfer switches.
  13. Lighting equipment and controls.
  14. Communication systems, including intercommunication clocks and programming, voice and data, and television equipment.
  15. Bio retention beds.

- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  2. Documentation: Review the following items in detail:
    - a. 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. Emergencies: Include the following, as applicable:
    - a. Instructions on meaning of warnings, trouble indications, and error messages.
    - b. Instructions on stopping.
    - c. Shutdown instructions for each type of emergency.
    - d. Operating instructions for conditions outside of normal operating limits.
    - e. Sequences for electric or electronic systems.
    - f. Special operating instructions and procedures.
  4. Operations: Include the following, as applicable:
    - a. Startup procedures.
    - b. Equipment or system break-in procedures.
    - c. Routine and normal operating instructions.
    - d. Regulation and control procedures.
    - e. Control sequences.
    - f. Safety procedures.
    - g. Instructions on stopping.
    - h. Normal shutdown instructions.
    - i. Operating procedures for emergencies.
    - j. Operating procedures for system, subsystem, or equipment failure.
    - k. Seasonal and weekend operating instructions.
    - l. Required sequences for electric or electronic systems.
    - m. Special operating instructions and procedures.
  5. Adjustments: Include the following:
    - a. Alignments.
    - b. Checking adjustments.
    - c. Noise and vibration adjustments.
    - d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
  
7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
  
8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.
- B. Set up instructional equipment at instruction location.

#### 3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
  2. Owner will furnish an instructor to describe Owner's operational philosophy.
  3. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  1. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- C. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral or a demonstration performance-based test.
- D. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

## 3.3 DEMONSTRATION AND TRAINING DVD'S

- A. DVD Format: Provide standard 12 mm DVD.
- B. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
- C. Narration: Describe scenes on videotape by audio narration by microphone while videotape is recorded or dubbing audio narration off-site after videotape is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.
- D. Transcript: Provide a typewritten transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

END OF SECTION 017900



## SECTION 018113 - SUSTAINABLE DESIGN 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. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain LEED -Certified certification based on LEED for Schools.
  - 1. Other LEED prerequisites and credits needed to obtain LEED certification depend on material selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
  - 2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
  - 3. A copy of the LEED Project checklist is attached at the end of this Section for information only.
- B. Related Sections:
  - 1. Divisions 01 through 33 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.

## 1.3 DEFINITIONS

- A. LEED: Leadership in Energy & Environmental Design.
- B. Rapidly Renewable Materials: Materials made from plants that are typically harvested within a 10-year or shorter cycle. Rapidly renewable materials include products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, or wool.
- C. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
- D. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles from Project site. Manufacturing refers to the final assembly of components into the building product that is installed at Project site.
- E. Regionally Extracted and Manufactured Materials: Regionally manufactured materials made from raw materials that are extracted, harvested, or recovered within a radius of 500 miles from Project site.

- F. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
  2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.
- G. Recycled Content: The percentage by weight of constituents that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process (pre-consumer), or after consumer use (post-consumer).
1. Spills and scraps from the original manufacturing process that are combined with other constituents after a minimal amount of reprocessing for use in further production of the same product are not recycled materials.
  2. Discarded materials from one manufacturing process that are used as constituents in another manufacturing process are pre-consumer recycled materials.

#### 1.4 LEED GOALS IMPLEMENTATION

- A. Contractor shall designate an on-site party (or parties) responsible for instructing workers and overseeing the Environmental Goals for the Project.
- B. Subcontractor shares Contractor's and Owner's commitment to implement work practices shall be consistent with requirements necessary to achieve LEED Certification. Each spec section will identify the applicable LEED Credit being sought, as well as reference to corresponding LEED requirement and submittal details.
- C. Subcontractor will provide supporting documentation for each applicable LEED credit being sought in Subcontractor's scope.
- D. Distribution: The Contractor shall distribute copies of the LEED Goals to the Job-Site Foreman, each Subcontractor, the Owner, and the Architect.
- E. Meetings: LEED and Environmental Goals shall be discussed at the following meetings:
1. Pre-bid meeting
  2. Pre-construction meeting
  3. Regular job-site meetings
- F. The Owner has hired a Commissioning Authority to direct the commissioning process for this project. Commissioning seeks to improve the way buildings are designed, constructed and delivered to the Owner and the occupants. Commissioning is a quality process that requires the project team to integrate quality into the design and construction process. The commissioning specification for this project encompasses four elements:
1. Providing contractors with requirements to improve the way they do things - resulting in better installations
  2. Ensuring through documented observation and testing that systems actually are installed and perform correctly.
  3. Ensuring that excellent O&M documentation is left with the owner and the user.

4. Ensuring that owner staff is expertly trained in O&M procedures.

## 1.5 SUBMITTALS

- A. General: Submit additional LEED submittals required by other Specification Sections.
- B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.
- C. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
  1. Furniture.
  2. Plumbing.
  3. Mechanical.
  4. Electrical.
  5. Specialty items such as elevators and equipment.
  6. Wood-based construction materials.
- D. LEED Action Plans: Provide preliminary submittals within seven days of date established for commencement of the Work indicating how the following requirements will be met:
  1. Credit MR 2.1: Waste management plan complying with Division 01 Section "Construction Waste Management and Disposal."
  2. Credit MR 4.1: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
  3. Credit MR 5.1: List of proposed regionally manufactured materials and regionally extracted and manufactured materials.
    - a. Identify each regionally extracted and manufactured material, including its source and cost.
  4. Credit EQ 3.1: Construction indoor-air-quality management plan, during construction.
  5. Credit EQ 3.2: Construction indoor-air-quality management plan, before occupancy.
- E. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:
  1. Credit MR 2.1: Waste reduction progress reports complying with Division 01 Section "Construction Waste Management and Disposal."
  2. Credit MR 4.1: Recycled content.
  3. Credit MR 5.1: Regionally manufactured materials and regionally extracted and manufactured materials.
- F. LEED Calculations:
  1. Construction Waste Management: Calculations for MR Credit 2 Construction Waste Management: Provide calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged. Complete Calculator MRc2.
  2. Materials Credits Mrc4-Mrc7: Complete the LEED Calculation Mrc4-Mrc7 spreadsheet (or equal), which should include total costs of all materials used on the project excluding labor and equipment for Divisions 03-10 and 31, 32, and 33.

3. MR Credit 4 Recycled-Content Materials - LEED Calculator MRc4: On LEED Calculator MRc4, highlight recycled content materials and include the percentage of post-consumer and post-industrial recycled content for all recycled content materials, and calculations demonstrating that the post-consumer plus one-half of the post-industrial recycled content constitutes at least 5% of the total value of the materials in the project OR combined post-consumer and one-half post-industrial recycled content constitutes at least 10%.
4. MR Credit 5 Local/Regional Materials – LEED Calculator MRc5: Highlight locally extracted, processed and manufactured materials and include the costs of all materials for the project and calculations demonstrating that 20% of building materials are manufactured within 500 miles of the project AND/OR 50% of those locally materials are extracted, processed and manufactured within a 500 mile radius.

G. LEED Documentation Submittals:

1. SS Credit 7.2: Provide specs and cut sheets for high-albedo materials applied highlighting the Solar Reflectance Index. Include calculations to this effect.
2. WE Credit 3.1, 3.2 and Credit 3.3: Product Data for all plumbing fixtures indicating water usage rates.
3. Prerequisite EA 3.0: Product Data for new HVAC equipment indicating absence of CFC-based refrigerants.
4. Credit MR 2.1: Comply with Division 01 Section "Construction Waste Management and Disposal."
5. Credit MR 4.1: Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
6. Credit MR 5.1: Product data indicating location of material manufacturer for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material and for each regionally extracted and manufactured material.
  - a. Include statement indicating distance from manufacturer to Project for each regionally manufactured material.
  - b. Include statement indicating location of and distance from Project to point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials.
7. Credit EQ 3.1:
  - a. Construction indoor-air-quality management plan.
  - b. Product data for temporary filtration media.
  - c. Product data for filtration media used during occupancy.
  - d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
8. Credit EQ 3.2:
  - a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
  - b. Product data for filtration media used during flush-out and during occupancy.
  - c. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.

9. Credit EQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.
10. Credit EQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating chemical composition and VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.
11. Credit EQ 4.4: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

## 1.6 QUALITY ASSURANCE

- A. LEED Coordinator: Provide and identify an individual to coordinate LEED requirements for Contractor. LEED coordinator may also serve as waste management coordinator.

## PART 2 - PRODUCTS

### 2.1 RECYCLED CONTENT OF MATERIALS

- A. Credit MR 4.1: Provide building materials with recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 10 percent of cost of materials used for Project.
  1. Cost of post-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
  2. Cost of pre-consumer recycled content of an item shall be determined by dividing weight of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
  3. Do not include furniture, plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

### 2.2 REGIONAL MATERIALS

- A. Credit MR 5.1: Provide a minimum of 10 percent of materials (by cost) that are regionally extracted and manufactured materials.

### 2.3 LOW-EMITTING MATERIALS

- A. Credit EQ 4.1: For field applications that are inside the weatherproofing system, use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D:
  1. Wood Glues: 30 g/L.
  2. Metal to Metal Adhesives: 30 g/L.
  3. Adhesives for Porous Materials (Except Wood): 50 g/L.
  4. Subfloor Adhesives: 50 g/L.
  5. Plastic Foam Adhesives: 50 g/L.
  6. Carpet Adhesives: 50 g/L.
  7. Carpet Pad Adhesives: 50 g/L.
  8. VCT and Asphalt Tile Adhesives: 50 g/L.

9. Cove Base Adhesives: 50 g/L.
10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesive: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesive: 100 g/L.
18. Structural Wood Member Adhesive: 140 g/L.
19. Special Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, Teflon, ultra-high molecular weight polyethylene, rubber or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
20. Top and Trim Adhesive: 250 g/L.
21. Plastic Cement Welding Compounds: 250 g/L.
22. ABS Welding Compounds: 325 g/L.
23. CPVC Welding Compounds: 490 g/L.
24. PVC Welding Compounds: 510 g/L.
25. Adhesive Primer for Plastic: 550 g/L.
26. Plastic Cement Welding Compounds: 350 g/L.
27. ABS Welding Compounds: 400 g/L.
28. CPVC Welding Compounds: 490 g/L.
29. PVC Welding Compounds: 510 g/L.
30. Adhesive Primer for Plastic: 650 g/L.
31. Sheet Applied Rubber Lining Adhesive: 850 g/L.
32. Aerosol Adhesive, General Purpose Mist Spray: 65 percent by weight.
33. Aerosol Adhesive, General Purpose Web Spray: 55 percent by weight.
34. Special Purpose Aerosol Adhesive (All Types): 70 percent by weight.
35. Other Adhesives: 250 g/L.
36. Architectural Sealants: 250 g/L.
37. Nonmembrane Roof Sealants: 300 g/L.
38. Single-Ply Roof Membrane Sealants: 450 g/L.
39. Other Sealants: 420 g/L.
40. Sealant Primers for Nonporous Substrates: 250 g/L.
41. Sealant Primers for Porous Substrates: 775 g/L.
42. Modified Bituminous Sealant Primers: 500 g/L.
43. Other Sealant Primers: 750 g/L.

B. Credit EQ 4.2: For field applications that are inside the weatherproofing system, use paints and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D:

1. Flat Paints, Coatings, and Primers: VOC not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC not more than 150 g/L.
3. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
5. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
6. Floor Coatings: VOC not more than 100 g/L.
7. Shellacs, Clear: VOC not more than 730 g/L.
8. Shellacs, Pigmented: VOC not more than 550 g/L.
9. Stains: VOC not more than 250 g/L.
10. Flat Interior Topcoat Paints: VOC not more than 50 g/L.
11. Nonflat Interior Topcoat Paints: VOC not more than 150 g/L.
12. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
13. Clear Wood Finishes, Varnishes and Sanding Sealers: VOC not more than 350 g/L.
14. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.

- 15. Floor Coatings: VOC not more than 100 g/L.
- 16. Shellacs, Clear: VOC not more than 730 g/L.
- 17. Shellacs, Pigmented: VOC not more than 550 g/L.
- 18. Stains: VOC not more than 250 g/L.
- 19. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
- 20. Dry-Fog Coatings: VOC not more than 400 g/L.
- 21. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
- 22. Pretreatment Wash Primers: VOC not more than 420 g/L.
- 23. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
- 24. Restricted Components: Paints and coatings shall not contain any of the following:
  - a. Acrolein.
  - b. Acrylonitrile.
  - c. Antimony.
  - d. Benzene.
  - e. Butyl benzyl phthalate.
  - f. Cadmium.
  - g. Di (2-ethylhexyl) phthalate.
  - h. Di-n-butyl phthalate.
  - i. Di-n-octyl phthalate.
  - j. 1,2-dichlorobenzene.
  - k. Diethyl phthalate.
  - l. Dimethyl phthalate.
  - m. Ethylbenzene.
  - n. Formaldehyde.
  - o. Hexavalent chromium.
  - p. Isophorone.
  - q. Lead.
  - r. Mercury.
  - s. Methyl ethyl ketone.
  - t. Methyl isobutyl ketone.
  - u. Methylene chloride.
  - v. Naphthalene.
  - w. Toluene (methylbenzene).
  - x. 1,1,1-trichloroethane.
  - y. Vinyl chloride.

- C. Credit EQ 4.3: Do not use composite wood or agrifiber products or adhesives that contain urea-formaldehyde resin.
- D. Low Emitting Materials – LEED 2.1 Product Requirements for EQ Credit 4.1, 4.2, 4.3.
- E. South Coast Rule #1168 by the South Coast Air Quality Management District (<http://www.aqmd.gov/rules/reg/reg11/r1168.pdf>) Limits on VOCs in grams per liter for adhesives and sealants used on interior of building are as follows:

Architectural Applications	Current VOC Limit (g/L)
Indoor Carpet Adhesives	50
Carpet Pad Adhesives	50
Outdoor Carpet Adhesives	150

Wood Flooring Adhesive	100
Rubber Floor Adhesives	60
Sub floor Adhesives	50
Ceramic Tile Adhesives	65
VCT and Asphalt Tile Adhesives	50
Dry Wall and Panel Adhesives	50
Cove Base Adhesives	50
Multipurpose Construction Adhesives	70
Structural Glazing Adhesives	100
Single Ply Roof Membrane Adhesives	250

Specialty Applications	VOC Limits and Effective Dates**			
	Current VOC Limit	1-1-05	7-1-05	1-1-07
PVC Welding	510			
CPVC Welding	490			
ABS Welding	400		325	
Plastic Cement Welding	350	250		
Adhesive Primer for Plastic	650		550	
Computer Diskette Manufacturing	350			
Contact Adhesive	80			
Special Purpose Contact Adhesive	250			
Tire Retread	100			
Adhesive Primer for Traffic Marking Tape	150			
Structural Wood Member Adhesive	140			
Sheet Applied Rubber Lining Operations	850			
Top and Trim Adhesive	540			250

\*\* The specified limits remain in effect unless revised limits are listed in subsequent columns.

For adhesives, adhesive bonding primers, or any other primer not regulated by the above two tables and applied to the following substrates, the following limits shall apply:

Substrate Specific Applications	Current VOC Limit
Metal to Metal	30
Plastic Foams	50
Porous Material (except wood)	50
Wood	30
Fiberglass	80



If an adhesive is used to bond dissimilar substrates together the adhesive with the highest VOC content shall be allowed.

<b>Sealants</b>	<b>Current VOC Limit</b>
Architectural	250
Marine Deck	760
Nonmembrane Roof	300
Roadway	250
Single-Ply Roof Membrane	450
Other	420
<b>Sealant Primers</b>	<b>Current VOC Limit</b>
Architectural	
Non Porous	250
Porous	775
Modified Bituminous	500
Marine Deck	760
Other	750

F. **Paints and Coatings:** The volatile organic compound (VOC) content of interior paints, interior primers, and anti-corrosive paints used in interior applications shall not exceed the limits defined in the Green Seal Environmental Standards for Paints (GS-11, dated 5/20/93) and Anti-Corrosive Paints (GC-03, dated 1/7/97), of Green Seal, Washington, DC. The VOC limits defined in the referenced Green Seal standards are as follows. All VOC limits are defined in grams per liter, and exclude water and tinting color added at the point of sale (as determined by U.S. EPA Reference Test Method 24).

<u><b>Interior Paints &amp; Primers</b></u>		<u><b>Anti-Corrosive Paints</b></u>	
Non-flat:	150	Gloss:	250
Flat:	50	Semi-gloss:	250
		Flat:	250

**Grams of VOC Per Liter of Coating, Less Water and Less Exempt Compounds**

<b>COATING CATEGORY</b>	<b>VOC Limit (g/l)</b>
Clear Wood Finishes	350
Varnish	350
Lacquer	550
Floor Coatings	100
<b>Sealers</b>	
Waterproofing sealers	250
Sanding sealers	275
All other sealers	200

Stains, Interior	250
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- G. Credit EQ 4.3: Do not use composite wood or agrifiber products or adhesives that contain urea-formaldehyde resin.

### PART 3 - EXECUTION

#### 3.1 CONSTRUCTION WASTE MANAGEMENT

- A. Credit MR 2.1: Comply with Division 01 Section "Construction Waste Management and Disposal."

#### 3.2 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

- A. Credit EQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."

1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
2. Replace all air filters immediately prior to occupancy.

- B. Credit EQ 3.2: Comply with one of the following requirements:

1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.
2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate determined in EQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space.
3. Air-Quality Testing:

- a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "LEED-NC: Reference Guide."
- b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:

- 1) Formaldehyde: 50 ppb.
- 2) Particulates (PM10): 50 micrograms/cu. m.
- 3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
- 4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
- 5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.

- c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been

met. When retesting noncomplying building areas, take samples from same locations as in the first test.

- d. Air-sample testing shall be conducted as follows:
- 1) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
  - 2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
  - 3) Number of sampling locations will vary depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.
  - 4) Air samples shall be collected between 3 and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

END OF SECTION 018113



# LEED for Schools 2007 DRAFT - Project Checklist

Project Name: Ocean Avenue Elementary School  
Project Address: Portland, Maine

Yes ? No

## 6 6 4 Sustainable Sites 16 Points

Y		Prereq 1	<b>Construction Activity Pollution Prevention</b>	Required
Y		Prereq 2	<b>Environmental Site Assessment</b>	Required
		Credit 1	<b>Site Selection</b>	1
		Credit 2	<b>Development Density &amp; Community Connectivity</b>	1
		Credit 3	<b>Brownfield Redevelopment</b>	1
	1	Credit 4.1	<b>Alternative Transportation, Public Transportation Access</b>	1
	1	Credit 4.2	<b>Alternative Transportation, Bicycle Use</b>	1
1		Credit 4.3	<b>Alternative Transportation, Low-Emitting &amp; Fuel-Efficient Vehicles</b>	1
		Credit 4.4	<b>Alternative Transportation, Parking Capacity</b>	1
	1	Credit 5.1	<b>Site Development, Protect or Restore Habitat</b>	1
1		Credit 5.2	<b>Site Development, Maximize Open Space</b>	1
1		Credit 6.1	<b>Stormwater Design, Quantity Control</b>	1
1		Credit 6.2	<b>Stormwater Design, Quality Control</b>	1
	1	Credit 7.1	<b>Heat Island Effect, Non-Roof</b>	1
1		Credit 7.2	<b>Heat Island Effect, Roof</b>	1
		Credit 8	<b>Light Pollution Reduction</b>	1
	1	Credit 9	<b>Site Master Plan</b>	1
1		Credit 10	<b>Joint Use of Facilities</b>	1

Yes ? No

## 5 1 1 Water Efficiency 7 Points

1		Credit 1.1	<b>Water Efficient Landscaping, Reduce by 50%</b>	1
1		Credit 1.2	<b>Water Efficient Landscaping, No Potable Use or No Irrigation</b>	1
		Credit 2	<b>Innovative Wastewater Technologies</b>	1
1		Credit 3.1	<b>Water Use Reduction, 20% Reduction</b>	1
1		Credit 3.2	<b>Water Use Reduction, 30% Reduction</b>	1
1		Credit 3.3	<b>Water Use Reduction, 40% Reduction</b>	1
	1	Credit 4	<b>Process Water Use Reduction, 20% Reduction</b>	1

6 4 1

## Energy & Atmosphere 17 Points

Y		Prereq 1	<b>Fundamental Commissioning of the Building Energy Systems</b>	Required
Y		Prereq 2	<b>Minimum Energy Performance</b>	Required
Y		Prereq 3	<b>Fundamental Refrigerant Management</b>	Required
6		Credit 1	<b>Optimize Energy Performance (2 pt minimum)</b>	2 to 10
			14% New Buildings or 7% Existing Building Renovations	2
			17.5% New Buildings or 10.5% Existing Building Renovations	3
			21% New Buildings or 14% Existing Building Renovations	4
			24.5% New Buildings or 17.5% Existing Building Renovations	5
			28% New Buildings or 21% Existing Building Renovations	6
			31.5% New Buildings or 24.5% Existing Building Renovations	7
			35% New Buildings or 28% Existing Building Renovations	8
			38.5% New Buildings or 31.5% Existing Building Renovations	9
			42% New Buildings or 35% Existing Building Renovations	10
		Credit 2	<b>On-Site Renewable Energy</b>	1 to 3
			2.5% Renewable Energy	1
			7.5% Renewable Energy	2
			12.5% Renewable Energy	3
	1	Credit 3	<b>Enhanced Commissioning</b>	1
	1	Credit 4	<b>Enhanced Refrigerant Management</b>	1
	1	Credit 5	<b>Measurement &amp; Verification</b>	1
	1	Credit 6	<b>Green Power</b>	1

continued...

**Materials & Resources**

Y			Prereq 1	<b>Storage &amp; Collection of Recyclables</b>	Required
		<b>1</b>	Credit 1.1	<b>Building Reuse</b> , Maintain 75% of Existing Walls, Floors & Roof	1
		<b>1</b>	Credit 1.2	<b>Building Reuse</b> , Maintain 95% of Existing Walls, Floors & Roof	1
		<b>1</b>	Credit 1.3	<b>Building Reuse</b> , Maintain 50% of Interior Non-Structural Elements	1
<b>1</b>			Credit 2.1	<b>Construction Waste Management</b> , Divert 50% from Disposal	1
	<b>1</b>		Credit 2.2	<b>Construction Waste Management</b> , Divert 75% from Disposal	1
	<b>1</b>		Credit 3.1	<b>Materials Reuse</b> , 5%	1
	<b>1</b>		Credit 3.2	<b>Materials Reuse</b> , 10%	1
<b>1</b>			Credit 4.1	<b>Recycled Content</b> , 10% (post-consumer + ½ pre-consumer)	1
	<b>1</b>		Credit 4.2	<b>Recycled Content</b> , 20% (post-consumer + ½ pre-consumer)	1
<b>1</b>			Credit 5.1	<b>Regional Materials</b> , 10% Extracted, Processed & Manufactured Regionally	1
	<b>1</b>		Credit 5.2	<b>Regional Materials</b> , 20% Extracted, Processed & Manufactured Regionally	1
	<b>1</b>		Credit 6	<b>Rapidly Renewable Materials</b>	1
		<b>1</b>	Credit 7	<b>Certified Wood</b>	1

**Indoor Environmental Quality**

Y			Prereq 1	<b>Minimum IAQ Performance</b>	Required
<b>Y</b>			Prereq 2	<b>Environmental Tobacco Smoke (ETS) Control</b>	Required
<b>Y</b>			Prereq 3	<b>Minimum Acoustical Performance</b>	Required
<b>1</b>			Credit 1	<b>Outdoor Air Delivery Monitoring</b>	1
<b>1</b>			Credit 2	<b>Increased Ventilation</b>	1
<b>1</b>			Credit 3.1	<b>Construction IAQ Management Plan</b> , During Construction	1
<b>1</b>			Credit 3.2	<b>Construction IAQ Management Plan</b> , Before Occupancy	1
<b>4</b>			Credit 4	<b>Low-Emitting Materials</b>	1 to 4
<b>1</b>			Credit 5	<b>Indoor Chemical &amp; Pollutant Source Control</b>	1
<b>1</b>			Credit 6.1	<b>Lighting System Design &amp; Controllability</b>	1
	<b>1</b>		Credit 6.2	<b>Thermal Comfort</b> , Controllability	1
<b>1</b>			Credit 7.1	<b>Thermal Comfort</b> , Design	1
<b>1</b>			Credit 7.2	<b>Thermal Comfort</b> , Verification	1
<b>1</b>	<b>1</b>		Credit 8.1	<b>Daylight &amp; Views</b> , Daylighting	1 to 3
	<b>1</b>			75% of classrooms ( <i>required for either points below</i> )	1
	<b>1</b>			90% of classrooms	2
				75% of other spaces	3
<b>1</b>			Credit 8.2	<b>Daylight &amp; Views</b> , Views for 90% of Spaces	1
	<b>1</b>		Credit 9	<b>Enhanced Acoustical Performance</b>	1 to 2
		<b>1</b>	Credit 10	<b>Mold Prevention</b>	1

**Innovation & Design Process**

<b>1</b>			Credit 1.1	<b>Innovation in Design</b> : Student Building Power Usage Monitoring	1
<b>1</b>			Credit 1.2	<b>Innovation in Design</b> : Provide Specific Title	1
	<b>1</b>		Credit 1.3	<b>Innovation in Design</b> : Stormwater site Integration	1
	<b>1</b>		Credit 1.4	<b>Innovation in Design</b> : Provide Specific Title	1
<b>1</b>			Credit 2	<b>LEED® Accredited Professional</b>	1
<b>1</b>			Credit 3	<b>School as a Teaching Tool</b>	1

**Project Totals (pre-certification estimates)**

**Certified:** 29-36 points, **Silver:** 37-43 points, **Gold:** 44-57 points, **Platinum:** 58-79 points

## SECTION 019000 – SAMPLE FORMS

The following information is provided for informational purposes only. The samples below are available electronically upon request. These are administrative forms only, not contractual.

1. Sample copies of the following are included at the end of this section.
  - **GC Request for Information (RFI):**
    - Contractor to submit request for clarifications, additional information or interpretation through Request for Information form (see attached sample form).
    - Only one topic/subject item per RFI
    - RFI's to be sequentially numbered
    - Specification/drawing reference required
    - Contractor may use his own form as long as basic information is included similar to the sample form.
    - A log of RFI's will be maintained by the Architect.
  - **Architect Information Bulletin (IB)**
    - Architect will respond to RFI's through Information Bulletin (see attached sample form). IB's may also be used to issue additional information such as drawings, sketches, requests for change proposal, response to Contractor's change proposals and general information.
    - IB's shall be sequentially numbered with subsequently issued IB's relating to the same issue/subject being numbered in outline style ie. IB#1, IB#1.1, IB#1.2, etc.
    - IB's are not direction to proceed with work which modifies the Contract Sum or Contract Time unless specifically indicated in the IB.
    - A log of IB's will be maintained by the Architect.
  - **CG Change Order Request (Proposal) (COP)**
    - Contractor to notify Architect of proposed changes in contract amount and/or contract time thorough COP (see attached sample form).
    - Only one item/issue per COP.
    - COP to be numbered sequentially with any subsequently issued COP's relating to the same issue/subject being numbered in outline style ie. COP#1, COP#1.1, COP#1.2, etc.
    - A log of COP's will be maintained by the Architect.
    - Architect will respond in writing to COP's
    - Architect will prepare a Change Order including approved COP's prior to each Contractor's Requisition for Payment.

END OF DOCUMENT 019000

**REQUEST FOR INFORMATION**

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Project: \_\_\_\_\_ RFI #: \_\_\_\_\_  
To: \_\_\_\_\_ From: \_\_\_\_\_  
Re: \_\_\_\_\_ Date: \_\_\_\_\_  
A/E Project #: \_\_\_\_\_  
Contract For: \_\_\_\_\_

---

Specification Section: \_\_\_\_\_ Paragraph: \_\_\_\_\_  
Drawings Reference: \_\_\_\_\_ Detail: \_\_\_\_\_

---

Description:

Signed by:

---

Attach-

Copies to:



**Information Bulletin 001**

Project:  
WBRC Project Number:  
Date:

To:  
**Name**  
Address  
City, State, Zip

From:  
**WBRC ARCHITECTS • ENGINEERS**  
44 Central Street  
Bangor, ME 04401-5116  
(207) 947-4511 phone (207) 947-4628 fax  
[www.wbrcae.com](http://www.wbrcae.com)

Contractor RFI #
XXX

Copy To	People	Via

The work shall be performed in accordance with the following information, which is issued as a clarification or interpretation of the contract documents. This is not direction to proceed with work, which modifies the Contract Sum or Contract Time. If the work described below will result in a change of contract sum or contract time, the contractor shall prepare a change order proposal for the owner's review and approval prior to performing the work.

Description

Attachments	Dated

Signed:  
  
**Your Name**  
*Department*



# GC CHANGE ORDER PROPOSAL

Project: \_\_\_\_\_

Change Order Proposal Number: \_\_\_\_\_

\_\_\_\_\_

From: \_\_\_\_\_

To: \_\_\_\_\_

Date: \_\_\_\_\_

\_\_\_\_\_

A/E Project Number: \_\_\_\_\_

Re: \_\_\_\_\_

Contract For: \_\_\_\_\_

This Change Order Proposal (C.O.P.) contains an itemized quotation for changes in the Contract Sum and/or Contract Time in response to proposed modifications to the Contract Documents based on Information Bulletin No. \_\_\_\_\_.

Description of Proposed Change:

Attached supporting information from:  Subcontractor  Supplier  \_\_\_\_\_  \_\_\_\_\_

Reason for Change:

Does Proposed Change involve a change in Contract Sum?  No  Yes [Increase] [Decrease] \$ \_\_\_\_\_  
Does Proposed Change involve a change in Contract Time?  No  Yes [Increase] [Decrease] \_\_\_\_\_ days

Attached pages:  Proposal Worksheet Summary: \_\_\_\_\_  
 Proposal Worksheet Detail(s): \_\_\_\_\_

Signed by:

Copies:  Architect  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  File

## SECTION 019113 - GENERAL COMMISSIONING 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.
- B. OPR and BoD documentation are included by reference for information only.

## 1.2 SUMMARY

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- B. Related Sections:
  - 1. Division 23 Section "Commissioning of HVAC" for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.
  - 2. Division 26 Section "Commissioning of Lighting and Lighting Controls" for commissioning process activities for communications systems, assemblies, equipment, and components.
- C. Systems to be commissioned:
  - 1. HVAC&R systems.
  - 2. Lighting and lighting controls.
  - 3. Building envelope.
  - 4. Data communication cabling.

## 1.3 DEFINITIONS

- A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- C. CxA: Commissioning Authority.
- D. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

#### 1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractors: Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:
  - 1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
  - 2. Representatives of the facility user and operation and maintenance personnel.
  - 3. Architect and engineering design professionals.

#### 1.5 OWNER'S RESPONSIBILITIES

- A. Provide the OPR documentation to the CxA and each Contractor for information and use.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

#### 1.6 EACH CONTRACTOR'S RESPONSIBILITIES

- A. Each Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
  - 1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
  - 2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
  - 3. Attend commissioning team meetings held on a variable basis.
  - 4. Integrate and coordinate commissioning process activities with construction schedule.
  - 5. Review and accept construction checklists provided by the CxA.
  - 6. Complete electronic construction checklists as Work is completed and provide to the Commissioning Authority on a weekly basis.
  - 7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
  - 8. Complete commissioning process test procedures.

#### 1.7 CxA'S RESPONSIBILITIES

- A. Organize and lead the commissioning team.
- B. Provide commissioning plan.
- C. Convene commissioning team meetings.

- D. Provide Project-specific construction checklists and commissioning process test procedures.
- E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 20 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.
- F. Prepare and maintain the Issues Log.
- G. Prepare and maintain completed construction checklist log.
- H. Witness systems, assemblies, equipment, and component startup.
- I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 019113

## SECTION 024116 - STRUCTURE DEMOLITION

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:

1. Demolition and removal of buildings and site improvements.
2. Removing below-grade construction.
3. Disconnecting, capping or sealing, and removing site utilities.
4. Salvaging items for reuse by Owner.

- B. Related Sections include the following:

1. Division 01 Section "Summary" for use of the premises and phasing requirements.
2. Division 01 Section "Temporary Facilities and Controls" for temporary construction, protection facilities, and environmental-protection measures for building demolition operations.
3. Division 01 Section "Construction Waste Management and Disposal" for recycling and disposal of nonhazardous demolition wastes and for removal and storage of refrigerant.
4. Division 22 Sections for demolishing or relocating site plumbing items.
5. Division 26 Sections for demolishing or relocating site electrical items.
6. Division 31 Section "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.

## 1.3 DEFINITIONS

- A. Demolish: Completely remove and legally dispose of off-site.
- B. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.
- C. Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

## 1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
  1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

## 1.5 SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Proposed Protection Measures: Submit informational report, including drawings, that indicates the measures proposed for protecting individuals and property , for environmental protection , for dust control and , for noise control. Indicate proposed locations and construction of barriers.
  - 1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain.
- C. Schedule of Building Demolition Activities: Indicate the following:
  - 1. Detailed sequence of demolition work, with starting and ending dates for each activity.
  - 2. Temporary interruption of utility services.
  - 3. Shutoff and capping or re-routing of utility services.
- D. Building Demolition Plans: Drawings indicating the following:
  - 1. Locations of temporary protection.
- E. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- F. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
- G. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

## 1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Standards: Comply with ANSI A10.6 and NFPA 241.
- D. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to building demolition including, but not limited to, the following:
  - 1. Inspect and discuss condition of construction to be demolished.
  - 2. Review structural load limitations of existing structures.
  - 3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review and finalize protection requirements.
  - 5. Review procedures for [**noise control**] [**and**] [**dust control**].
  - 6. Review procedures for protection of adjacent buildings.
  - 7. Review items to be salvaged and returned to Owner.

## 1.7 PROJECT CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
- B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
  - 1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
  - 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
    - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.
- C. Owner assumes no responsibility for buildings and structures to be demolished.
  - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- 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 materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. On-site storage or sale of removed items or materials is not permitted.

## 1.8 COORDINATION

- A. Arrange demolition schedule so as not to interfere with Owner's on-site operations or operations of adjacent occupied buildings.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. Satisfactory Soils: Comply with requirements in Division 31 Section "Earth Moving."

## PART 3 - EXECUTION

### 3.1 DEMOLITION CONTRACTORS

- A. Provide a Licensed Demolition Contractor.

### 3.2 EXAMINATION

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

- B. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations. Comply with Division 01 Section "Photographic Documentation."
- D. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.
  - 1. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

### 3.3 PREPARATION

- A. Refrigerant: Remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction before starting demolition.
- B. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
  - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
  - 2. Arrange to shut off indicated utilities with utility companies.
  - 3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
  - 4. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
- C. Existing Utilities: Refer to Divisions 22 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.
- D. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
  - 1. Strengthen or add new supports when required during progress of demolition.
- E. Salvaged Items: Comply with the following:
  - 1. Clean salvaged items of dirt and demolition debris.
  - 2. Pack or crate items after cleaning. Identify contents of containers.
  - 3. Store items in a secure area until delivery to Owner.
  - 4. Transport items to storage area designated by Owner.
  - 5. Protect items from damage during transport and storage.



### 3.4 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.
- B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
  - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
  - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
    - a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Division 01 Section "Temporary Facilities and Controls."
  - 1. Protect adjacent buildings and facilities from damage due to demolition activities.
  - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
  - 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
  - 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  - 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
  - 6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
  - 7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

### 3.5 DEMOLITION, GENERAL

- A. General: Demolish indicated existing buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
  - 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
  - 2. Maintain fire watch during and for at least 2 hours after flame cutting operations.
  - 3. Maintain adequate ventilation when using cutting torches.
  - 4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Engineering Surveys: During demolition, perform surveys to detect hazards that may result from building demolition activities.
- C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

D. Explosives: Use of explosives is not permitted.

### 3.6 DEMOLITION BY MECHANICAL MEANS

A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.

C. Salvage: Items to be salvaged are indicated below:

1. Doors and door hardware.
2. Windows.
3. Cabinets.
4. Mirrors.
5. Chalkboards.
6. Tackboards.
7. Marker boards.
8. Plumbing fixtures.

D. Below-Grade Construction: Demolish foundation walls and other below-grade construction.

1. Remove below-grade construction, including basements, foundation walls, and footings, completely.

E. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.

1. Piping: Disconnect piping at unions, flanges, valves, or fittings.
2. Wiring Ducts: Disassemble into unit lengths and remove plug-in and disconnecting devices.

### 3.7 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with **[satisfactory soil materials] [recycled pulverized concrete] [recycled pulverized masonry]** according to backfill requirements in Division 31 Section "Earth Moving."

C. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

## 3.8 REPAIRS

- A. Promptly repair damage to adjacent buildings caused by demolition operations.

## 3.9 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site. See Division 01 Section "Construction Waste Management and Disposal" for recycling and disposal of demolition waste.
- B. Remove demolition waste materials from Project site and legally dispose of them in an EPA-approved landfill acceptable to authorities having jurisdiction.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- C. Do not burn demolished materials.

## 3.10 CLEANING

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

END OF SECTION 024116

## SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:

1. 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.

- B. Related Sections include the following:

1. Division 01 Section "Summary" for use of premises[, **and phasing,**] and Owner-occupancy requirements.
2. Division 01 Section "Photographic Documentation" for preconstruction photographs taken before selective demolition operations.
3. Division 01 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
4. Division 01 Section "Cutting and Patching" for cutting and patching procedures.
5. Division 01 Section "Construction Waste Management and Disposal" for disposal of demolished materials.
6. Division 02 Section "Structure Demolition" for demolition of entire buildings, structures, and site improvements.
7. Division 31 Section "Site Clearing" for site clearing and removal of above- and below-grade improvements.

## 1.3 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: Detach items from existing construction and deliver them to Owner[ **ready for reuse**].
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

## 1.4 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, <Insert description of other items,> antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.
1. Coordinate with Owner's [archaeologist] [historical adviser], who will establish special procedures for removal and salvage.

## 1.5 SUBMITTALS

- A. Qualification Data: For [demolition firm] [professional engineer] [refrigerant recovery technician].
- B. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's [building manager's] [and] [other tenants'] on-site operations are uninterrupted.
  2. Interruption of utility services. Indicate how long utility services will be interrupted.
  3. Coordination for shutoff, capping, and continuation of utility services.
  4. Use of elevator and stairs.
  5. Locations of proposed dust- and noise-control temporary partitions and means of egress[, including for other tenants affected by selective demolition operations].
  6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
  7. Means of protection for items to remain and items in path of waste removal from building.
- C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- D. Predemolition [Photographs] [or] [Videotapes]: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Comply with Division 01 Section "Photographic Documentation." Submit before Work begins.
- E. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
1. Comply with submittal requirements in Division 01 Section "Construction Waste Management and Disposal."

## 1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- C. LEED Requirements for Building Reuse:

1. Credit MR 1.1[ **and 1.2**]: Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
  2. Credit MR 1.3: Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
  3. Credit MR 1.2[ **and 1.3**]: Maintain existing nonshell, nonstructural components (walls, flooring, and ceilings) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
- D. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- E. Standards: Comply with ANSI A10.6 and NFPA 241.
- F. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
- G. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:
1. Inspect and discuss condition of construction to be selectively demolished.
  2. Review structural load limitations of existing structure.
  3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
  5. Review areas where existing construction is to remain and requires protection.

#### 1.7 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
1. Comply with requirements specified in Division 01 Section "Summary."
- 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:
    - a. **<Insert items to be removed by Owner.>**
- C. 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**] [**have been removed by Owner under a separate contract**].

2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
- E. Hazardous Materials: It is unknown whether hazardous materials will be encountered in the Work.
1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
- F. Hazardous Materials: Hazardous materials are present in construction 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.
- G. Storage or sale of removed items or materials on-site is not permitted.
- H. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
1. Maintain fire-protection facilities in service 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 (Not Used)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. 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.
- E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

- F. Survey of Existing Conditions: Record existing conditions by use of **[measured drawings]** **[preconstruction photographs]** **[preconstruction videotapes]** **[and]** **[templates]**.
1. Comply with requirements specified in Division 01 Section "Photographic Documentation."
  2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.
- G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. **[Owner]** **[Building manager]** 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, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
    - a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

### 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 Division 01 Section "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.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  4. Cover and protect furniture, furnishings, and equipment that have not been removed.



5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."
- 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.
1. Strengthen or add new supports when required during progress of selective demolition.

### 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. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  2. 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.
  3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  4. 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. Maintain **[ fire watch and ]** portable fire-suppression devices during flame-cutting operations.
  5. Maintain adequate ventilation when using cutting torches.
  6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  9. Dispose of demolished items and materials promptly. **[ Comply with requirements in Division 01 Section "Construction Waste Management and Disposal." ]**
- B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.
1. Building Structure and Shell: **[75] [100]** percent.
  2. Nonshell Elements: 50 percent.
- C. 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 **[on-site] [off-site] [designated by Owner] [indicated on Drawings]**.
  5. Protect items from damage during transport and storage.

- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. 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 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
- F. Roofing: Remove no more existing roofing than can be covered in one day by new roofing and so that building interior remains watertight and weathertight. Refer to Division 07 Section "<Insert Section name>" for new roofing requirements.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
  2. Remove existing roofing system down to substrate.
- G. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

### 3.6 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 Division 01 Section "Construction Waste Management and Disposal."

- B. Burning: Do not burn demolished materials.
- C. Burning: Burning of demolished materials will be permitted[ **only at designated areas on Owner's property,**] provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.
- D. Disposal: Transport demolished materials and dispose of at designated spoil areas on Owner's property.
- E. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### 3.7 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.

### 3.8 SELECTIVE DEMOLITION SCHEDULE

- A. Existing [**Items**] [**Construction**] to Be Removed: **<Insert description of items and construction to be removed.>**
- B. Existing Items to Be Removed and Salvaged: **<Insert description of items to be removed and salvaged.>**
- C. Existing Items to Be Removed and Reinstalled: **<Insert description of items to be removed and reinstalled.>**
- D. Existing Items to Remain: **<Insert description of items to remain.>**

END OF SECTION 024119

## SECTION 033000 - CAST-IN-PLACE CONCRETE

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Footings.
  - 2. Foundation walls.
  - 3. Slabs-on-grade.
  - 4. Slabs-on-metal decking.
  - 5. Grout.
- B. Related Sections include the following:
  - 1. Division 1 Section "Sustainable Design Requirements."
  - 2. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.
  - 3. Division 32 Section "Concrete Paving" for concrete pavement and walks.
- C. Products installed, but not furnished, under this Section include the following:
  - 1. Leveling plates, anchor rods and other embedded steel items under Division 05 Metals.
  - 2. Metal Nosings at stairs under Division 05 Metals.

## 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
  - 1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.

- b. Design Mixtures for Credit MR 4.1 and MR 4.2: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements and for equivalent concrete mixtures that do not contain portland cement replacements
  2. Credit MR 5.1 / 5.2: Product Data indicating location of material manufacturer for regionally manufactured materials.
    - a. Include statement indicating cost and distance from manufacturer to Project for each regional manufactured material.
- C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  1. Name and Location of the Concrete Supplier and Plant.
  2. Concrete Test Reports using the same mix design, such as on past projects.
  3. Indicate amounts of mixing water to be withheld for later addition at Project site.
  4. The methods proposed for curing and protection of concrete.
  5. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
    - a. Sieve analyses for coarse, fine and lightweight aggregates.
  6. Product Data Material Certificates: For each of the following, signed by manufacturers:
    - a. Cementitious materials.
    - b. Admixtures.
    - c. Steel reinforcement and accessories.
    - d. Waterstops.
    - e. Floor and slab treatments.
    - f. Joint-filler strips.
    - g. Repair materials.
- D. Sawcut control joint layout plan:
  1. On minimum  $1/8" = 1'-0"$  scale plans, submit proposed size, spacing and layout of sawcut control joints in slabs on grade as well as additional construction joints.
    - a. Coordinate with mandatory locations of construction joints are shown on the Drawings.
- E. Construction joint layout plan:
  1. On minimum  $1/16" = 1'-0"$  scale plans, submit proposed spacing and locations of construction joints in foundation walls prior to submitting and reviewing reinforcing steel shop drawings.
  2. On minimum  $1/16" = 1'-0"$  scale plans, submit proposed spacing and locations of construction joints in slabs-on-metal deck prior to submitting and reviewing reinforcing steel shop drawings.
- F. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Bar placement drawings shall be detailed on wall elevations; detailing on plans with schedules is unacceptable and will be rejected.
- G. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Concrete subcontractor.
  2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction, control and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
- F. The Owner will employ a qualified Testing Laboratory or Materials Engineer to make inspection tests during the course of work as specified herein and as otherwise considered necessary. Costs of all tests will be paid by the Owner.
- G. All measuring, mixing, placing, and curing shall be subject to inspection by the Testing Laboratory and approval by the Architect. However, such inspection and approval shall in no way relieve the General Contractor of his responsibility to fulfill the requirements of this Contract.
- H. Contractor shall cooperate in making tests and shall be responsible for notifying designated laboratory in sufficient time to allow making of cylinders at time of concrete placement.
- I. Contractor shall provide a covered box large enough to contain four (4) standard sets of concrete cylinders. At temperatures below 60 degrees F., box shall be electrically heated to maintain inside temperature of 60 to 80 degrees F. Cylinders shall be covered with moist burlap until delivery to laboratory, 24 to 72 hours after molding.
- J. Architect may require additional cylinders to be cured under field conditions when unusual conditions may tend to reduce concrete strength. Contractor shall cure these cylinders at the site under conditions that approximate the curing conditions of the representative concrete.

- K. Architect has authority to order, for any strength of concrete, increase in cement content and mix redesign for remaining work if either:
  - 1. Average 7 day strength of any two (2) tests representing a particular design is less than 66% of specified strength; or
  - 2. Average 28 day strength of any two (2) tests representing a particular design strength is less than 90% specified strength.
- L. Where concrete does not comply with these requirements, Architect shall have the right to require, at Contractor's expense:
  - 1. Test of hardened concrete cores according to ASTM C42.
  - 2. Load test on portion of structure affected.
- M. Where tests show that concrete is below specified strength, the Contractor shall remove all such concrete as directed by the Architect. Full cost of removal of low strength concrete and replacement with concrete of proper specified strength shall be borne by the Contractor, as shall all work required by such remedial action.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
  - 2. Products: Subject to compliance with requirements, provide one of the products specified.
  - 3. 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.
  - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

### 2.3 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
  2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. High-density overlay, Class 1 or better.
    - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
    - c. Structural 1, B-B or better; mill oiled and edge sealed.
    - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
  2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
  3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

## 2.4 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel with postconsumer recycled content not less than 75 percent and preconsumer recycled content not less than 10 percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

## 2.5 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire,



plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

## 2.6 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  1. Portland Cement: ASTM C 150, Type I or II.
  2. Include Supplementary Cementitious Materials as a percentage of cementitious materials at 25% by weight:
    - a. Fly Ash: ASTM C 618, Class C or F.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.
  1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
  2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 94/C 94M and potable.

## 2.7 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

## 2.8 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
  1. Products:
    - a. Colloid Environmental Technologies Company; Volclay Waterstop-RX.
    - b. Concrete Sealants Inc.; Conseal CS-231.
    - c. Greenstreak; Swellstop.
    - d. Henry Company, Sealants Division; Hydro-Flex.

- e. JP Specialties, Inc.; Earthshield Type 20.
- f. Progress Unlimited, Inc.; Superstop.
- g. TCMiraDRI; Mirastop.

## 2.9 FLOOR AND SLAB TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.

### 1. Products:

- a. Burke by Edoco; Titan Hard.
- b. ChemMasters; Chemisil Plus.
- c. ChemTec International; ChemTec One.
- d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Intraseal.
- e. Curecrete Distribution Inc.; Ashford Formula.
- f. Dayton Superior Corporation; Day-Chem Sure Hard.
- g. Euclid Chemical Company (The); Euco Diamond Hard.
- h. Kaufman Products, Inc.; SureHard.
- i. L&M Construction Chemicals, Inc.; Seal Hard.
- j. Meadows, W. R., Inc.; Liqui-Hard.
- k. Metalcrete Industries; Floorsaver.
- l. Nox-Crete Products Group, Kinsman Corporation; Duranox.
- m. Symons Corporation, a Dayton Superior Company; Buff Hard.
- n. US Mix Products Company; US Spec Industraseal.
- o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS.
- p. Approved Equal.

## 2.10 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.

## 2.11 RELATED MATERIALS

- A. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, per ASTM D 2240.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Reglets: Fabricate reglets of not less than 0.0217-inch- thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

## 2.12 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
  4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
  4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

## 2.13 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 25 percent.
  2. Combined Fly Ash and Pozzolan: 25 percent.
  3. Ground Granulated Blast-Furnace Slag: 50 percent.
  4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
  5. Silica Fume: 10 percent.
  6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
  7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
  2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

## 2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 3000 psi at 28 days.
  2. Maximum Water-Cementitious Materials Ratio: 0.50.
  3. Slump Limit: 5 inches, plus or minus 1 inch.
  4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
- B. Foundation Walls, Slabs-on-Metal Deck: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
  2. Maximum Water-Cementitious Materials Ratio: 0.45.
  3. Slump Limit: 4 inches, plus or minus 1 inch.
  1. Air Content:
    - a. Foundation walls: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size
    - b. Slabs on Metal Deck: Do not allow air content of trowel-finished floors to exceed 3 percent.
- C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
  2. Maximum Water-Cementitious Materials Ratio: 0.40.
  3. Slump Limit: 4 inches, plus or minus 1 inch.
  4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

## 2.15 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.16 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
  - 1. Class A, 1/8 inch for smooth-formed, exposed finished surfaces.
  - 2. Class C, 1/2 inch for rough-formed non-exposed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 1. Install keyways, reglets, recesses, and the like, for easy removal.
  - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete where specified on the Drawings.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
  - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
  - 3. Install dovetail anchor slots in concrete structures as indicated.

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 48

hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
  2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing when overnight temperatures drop less than 50 deg F for 7 days after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
  2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

### 3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  5. Space vertical joints in walls as indicated on the Drawings. Locate joints away from column piers integral with walls, but in concealed locations where possible.
  6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Grade: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random control cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
  2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated.

### 3.6 WATERSTOPS

- A. Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

### 3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  2. Maintain reinforcement in position on chairs during concrete placement.
  3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  4. Slope surfaces uniformly to drains where required.
  5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
- 3.8 FINISHING FORMED SURFACES
- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.



1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
  1. Apply float finish to surfaces to receive trowel finish.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
  2. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-foot- long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/8 inch
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
  1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
  1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route or as specified on the construction plans. Coordinate required final finish with Architect before application.

### 3.10 GROUTING OF LEVELING PLATES

- A. Grout Mixtures:

1. Use only approved prepackaged non-shrink grout for grouting under column base plates.
2. Where clearances are less than 2 inches or where the size and shape of the space make placement difficult, grout shall comprise only cement, non-metallic aggregate, sand, and water.
3. With either mix, use the minimum amount of water required to produce a flowable grout. Take care to avoid the use of excessive water which may cause segregation or bleeding.
4. Minimum ultimate compressive strength of grout shall be 5,000 psi at 7 days and 7,500 psi at 28 days.

B. Mixing:

1. The materials and water shall be mixed in a paddle type mortar mixer for not less than 3 minutes or it shall be thoroughly mixed by hand turning the entire mass over enough times to ensure even distribution of components.
2. Mix as close to the area to be grouted as possible. Provide adequate means to transport the mixed grout as quickly as possible, and in such manner as to prevent segregation.
3. Place grout within a period of 15 minutes or less after mixing. After the grout has been mixed, do not retemper by adding water.

C. Preparation:

1. Remove all defective concrete, laitance, dirt, oil, grease and loose material from the concrete foundation by bush hammering, chipping, or other approved means until sound, clean concrete is obtained. Leave the surface of the concrete reasonably rough but not so rough as to interfere with proper placing of the grout. Cover the area as completely as possible with a waterproof paper to prevent contamination prior to grouting.
2. Clean the bottom of the base plate or bearing plate of all dirt, oil, greases and loose materials. Align and level the plate in its final position and maintain in that position during grouting.
3. Take special care in hot or cold weather to ensure proper setting and gain of strength, in accordance with instructions of the manufacturer of the grouting material. Bring the concrete and plate to be grouted to a temperature of 65 to 75 degrees F., just prior to grouting.
4. Prior to grouting, clean the concrete surface by compressed air or other means. Saturate the surface of the concrete thoroughly with clean water. Remove free water just prior to placing the grout.
5. Take care that vibration of equipment or machinery operation nearby does not affect the normal set, strength and bond of the grout.

D. Grouting:

1. Place the grout quickly and continuously to avoid undesirable effects of overworking which might result in segregation, bleeding, or breaking down of initial set.
2. Grout may be cast in place, pressure grouted by gravity, or pumped.
3. Grout shall completely fill the space to be grouted. It shall be thoroughly compacted and free of air pockets.
4. Place grout from one side only and allow it to flow across to the open side to avoid air entrapment.

E. Finishing Unconfined Grout:

1. After the grout has acquired its initial set and will not sag, cut off all unconfined, exposed edges, leaving sloping "shoulders".

### 3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

### 3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

### 3.13 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
  - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  - 2. Apply to aged concrete in accordance with Manufacturer's recommendations.
  - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

### 3.14 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
  - 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

### 3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  - 2. After concrete has cured at least 14 days, correct high areas by grinding.
  - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to

- produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

### 3.16 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Concrete Construction is subject to the IBC's Chapter 17 requirements for "Structural Tests and Special Inspections." Contractor shall fully cooperate with timely scheduling and accessibility for these required tests and inspections. See Structural Drawing S-000 for a Program and Schedule of all required tests and inspections.
1. Payment for these services will be made by Owner.
  2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
  3. A third inspection of Work failing to comply with specified requirements shall be done at Contractor's expense.
  4. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
  5. Contractor shall schedule testing and inspections and 48 hours in advance of scheduled concrete delivery.
  6. Contractor shall not place any concrete encasing reinforcing steel, metal deck, shear studs, column base plates, or any other structural item until an Inspection has been made and the Work to be encased has been formally accepted.
- A. Inspections, include but are not limited to the following:
1. Steel reinforcement placement.
  2. Formwork geometry.
  3. Anchor rods and other embedded steel items.
  4. Verification of use of required design mixture.
  5. Concrete placement, including conveying and depositing.
  6. Curing procedures and maintenance of curing temperature.
  7. Verification of concrete strength before removal of shores and forms from beams and slabs.

- B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
  2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C 31/C 31M.
    - a. Cast sets of five standard cylinder specimens for each composite sample.
    - b. Field cure one standard cylinder specimens and lab cure four standard cylinders.
  6. Compressive-Strength Tests: ASTM C 39/C 39M:
    - a. Test one field-cured specimen at 3-days
    - b. Test one lab-cured specimen at 7-days.
    - c. Test two lab-cured specimens at 28-days.
    - d. If either of the 28-day break are below design strength, hold the fifth lab-cured specimen and test at 56-days, otherwise discard.
    - e. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
  7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
  8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
  9. Test results shall be reported in writing to Architect and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
  10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device are not permitted by Architect and cannot be used for approval or rejection of concrete.
  11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M.
  12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

## SECTION 034500 - PRECAST ARCHITECTURAL CONCRETE

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Architectural precast concrete window sill units.
  - 2. Architectural precast chimney cap.
- B. Products furnished, but not installed, under this Section include the following:
  - 1. Architectural precast concrete units, installed under Division 04 Section "Unit Masonry."

## 1.3 DEFINITION

- A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
  - 1. Loads: As indicated on the drawings.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittal:
  - 1. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
  - 2. Credit MR 5.1: Product Data indicating location of material manufacturer for regionally manufactured materials.
    - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.

- b. Include statement indicating cost and distance from point of extraction, harvest, or recovery to Project for each raw material used in regionally manufactured materials.
- C. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- D. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.
  - 1. Indicate separate face and backup mixture locations and thicknesses.
  - 2. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
  - 3. Indicate relationship of architectural precast concrete units to adjacent materials.
  - 4. Indicate locations and details of joint widths.
  - 5. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
- E. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.
  - 1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.
- F. Material Test Reports: For aggregates.
- G. Source quality-control test reports.

#### 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
  - 1. Participates in PCI's plant certification program and is designated a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units or participates in APA's "Plant Certification Program for Production of Architectural Precast Concrete Products" and is designated an APA-certified plant.
- B. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- C. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
- D. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."



- E. Mockups: Before production of architectural precast concrete units, construct full-sized mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup as indicated on Drawings for masonry mockup and architectural precast concrete complete with joint fillers.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents unless such deviations are specifically approved by Architect in writing.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.
- B. Support units during shipment on nonstaining shock-absorbing material.
- C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
- D. Place stored units so identification marks are clearly visible, and units can be inspected.
- E. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.

### PART 2 - PRODUCTS

#### 2.1 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
  - 1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- B. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

#### 2.2 REINFORCING MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

- C. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

### 2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
  - 1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
  - 1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
    - a. Gradation: Uniformly graded.
  - 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.
- C. Lightweight Aggregates: Except as modified by PCI MNL 117, ASTM C 330, with absorption less than 11 percent.
- D. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
  - 1. Colors: Allow for two colors approved by Architect.
- E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
- F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
  - 1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
  - 5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017 M.

### 2.4 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.

- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
- D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures or full-depth mixture by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
  - 1. Compressive Strength (28 Days): 5000 psi minimum.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

## 2.5 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
  - 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
  - 1. Form joints are not permitted on faces exposed to view in the finished work.
  - 2. Edge and Corner Treatment: See details on the drawings.

## 2.6 FABRICATION

- A. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
  - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
  - 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
  - 3. Place reinforcement to maintain at least 3/4-inch minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

- B. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.
- C. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- D. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- E. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
  - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- F. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.
  - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- G. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- H. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- I. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

## 2.7 FABRICATION TOLERANCES

- A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

## 2.8 FINISHES

- A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved mockups and as follows:
  - 1. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
- B. Finish exposed surfaces of architectural precast concrete units by smooth, steel-trowel finish.
- C. Finish unexposed surfaces of architectural precast concrete units by float finish.

## 2.9 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- B. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 requirements for concrete strength.
- C. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
  - 1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
  - 2. Cores will be tested in an air-dry condition.
  - 3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
  - 4. Test results will be made in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:
    - a. Project identification name and number.
    - b. Date when tests were performed.
    - c. Name of precast concrete fabricator.
    - d. Name of concrete testing agency.
    - e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- D. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Refer to Division 04 Section "Unit Masonry" for installation.

### 3.2 REPAIRS

- A. Repair architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements.
- B. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- C. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

- D. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

END OF SECTION 034500

## SECTION 042000 - UNIT MASONRY

## 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 work of this section will be provided as a Filed Sub Bid.
- B. This Section includes unit masonry assemblies consisting of the following:
  - 1. Concrete masonry units (CMUs).
  - 2. Decorative concrete masonry units.
  - 3. Face brick.
  - 4. Clay flue lining units.
  - 5. Mortar and grout.
  - 6. Reinforcing steel.
  - 7. Masonry joint reinforcement.
  - 8. Ties and anchors.
  - 9. Embedded flashing.
  - 10. Miscellaneous masonry accessories.
  - 11. Cavity-wall insulation.
- C. Related Sections include the following:
  - 1. Division 01 Section "Alternates" for information on alternate pertaining to this section.
  - 2. Division 05 Section "Metal Stairs" for locations and elevations of beam pockets and steel bearing plates.
  - 3. Division 07 Section "Air Barriers" for air barrier applied to cavity face of backup wythes of cavity walls.
  - 4. Division 07 Section "Sheet Metal Flashing and Trim" for sheet metal flashing.
  - 5. Division 07 Section "Joint Sealants" for sealing control and expansion joints in unit masonry.
- D. Products furnished, but not installed, under this Section include the following:
  - 1. Dovetail slots for masonry anchors, installed under Division 03 Section "Cast-in-Place Concrete."
- E. Products installed, but not furnished, under this Section include the following:
  - 1. Precast concrete trim units, furnished under Division 03 Section "Precast Architectural Concrete."
  - 2. Steel lintels for unit masonry, furnished under Division 05 Section "Metal Fabrications."
  - 3. Hollow-metal frames in unit masonry openings, furnished under Division 08 Section "Hollow Metal Doors and Frames."
  - 4. Hollow-metal frames in unit masonry openings, furnished under Division 14 Section "Hydraulic Elevators."

### 1.3 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
  - 1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls. Show coordination of reinforcing with beam and stringer pockets at Stair and Elevator shafts.
- C. Samples for Selection: For the following:
  - 1. Face brick, in the form of straps of five or more bricks.
  - 2. Decorative concrete masonry units.
  - 3. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
- D. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
  - 1. Masonry units.
    - a. Include material test reports substantiating compliance with requirements.
    - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
  - 2. Cementitious materials. Include brand, type, and name of manufacturer.
  - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  - 4. Grout mixes. Include description of type and proportions of ingredients.
  - 5. Reinforcing bars.
  - 6. Joint reinforcement.
  - 7. Anchors, ties, and metal accessories.
- E. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
  - 1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
  - 2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- F. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.
- G. LEED Submittals:
  - 1. Credit MR 2.1 and 2.2: Waste management plan complying with Division 01 Section "Construction Waste Management."



2. Credit MR 5.1: Product Data indicating location of material manufacturer for regionally manufactured materials.
  - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.
  - b. Include statement indicating cost and distance from point of extraction, harvest, or recovery to Project for each raw material used in regionally manufactured materials.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years experience.
- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548, will be contracted by the Owner.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- D. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Build mockups for typical exterior wall in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.
    - a. Include a sealant-filled joint at least 16 inches long in exterior wall mockup.
    - b. Include window opening in exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
    - c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
    - d. Include metal studs, sheathing, cavity insulation, veneer anchors, flashing, and weep holes in exterior masonry-veneer wall mockup.
  2. Clean exposed faces of mockups with masonry cleaner as indicated.
  3. Protect accepted mockups from the elements with weather-resistant membrane.
  4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
    - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.

- b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
- F. Preinstallation Conferences: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
- 1. At least 7 days prior to starting CMU masonry, conduct a meeting to review detailed requirements for mortar and grout mixes and to determine procedures for satisfactory construction and curing operations. Review requirements of submittals, status of coordinating work, and availability of materials. Review requirements tenting and heating. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Require representatives of each entity directly concerned with masonry construction to attend, including the following:
    - a. Contractor's superintendent.
    - b. Masonry foreman.
    - c. Architect.
  - 2. At least 7 days prior to starting veneer masonry, conduct a meeting to review detailed requirements for mortar mixes and to determine procedures for satisfactory construction and curing operations. Review requirements of submittals, status of coordinating work, and availability of materials. Review requirements tenting and heating. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Require representatives of each entity directly concerned with masonry construction to attend, including the following:
    - a. Contractor's superintendent.
    - b. Masonry foreman.
    - c. Architect.
- G. UL Listing:
- 1. Provide flue lining material that has been tested and listed to UL Standards.
  - 2. Provide concrete masonry units that has been tested and listed to UL Standards.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.7 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
  2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  2. Protect sills, ledges, and projections from mortar droppings.
  3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates or setting beds. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with the following requirements:
1. Cold-Weather Construction: When the anticipated daytime low temperature is within the limits indicated, use the following procedures:
    - a. 40 to 32 deg F (4 to 0 deg C): Heat mixing water or sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C).
    - b. 32 to 25 deg F (0 to -4 deg C): Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120 deg F (4 and 49 deg C). Heat masonry units to 40 deg F (4 deg C). Maintain mortar and grout above freezing until used in masonry. Use heat on both sides of walls under construction.
    - c. 25 to 20 deg F (-4 to -7 deg C): Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120 deg F (4 and 49 deg C). Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg F (4 deg C).
    - d. 20 deg F (-7 deg C) and Below: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C). Heat grout materials to produce grout temperatures between 40 and 120• F (4 and 49• C). Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg F (4 deg C).
  2. Cold-Weather Protection: When the anticipated daytime low temperature is within the limits indicated, coordinate with the General Contractor to provide the following protection. This is in addition to construction procedures specified above:
    - a. 40 to 32 deg F (4 to 0 deg C): Cover masonry with insulating blankets for 48 hours after construction.
    - b. 32 deg F (0 deg C) and Below: Provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 72 hours after construction.

3. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried out, but not less than 7 days after completion of cleaning.
- E. Hot-Weather Requirements: Coordinate with the General Contractor to protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
1. When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
  2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

### 2.2 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.
- B. Provide as many products as possible that are manufactured within 500 miles of project site.

### 2.3 CONCRETE MASONRY UNITS (CMUs)

- A. Shapes: Provide shapes indicated and as follows:
1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
  2. Provide square-edged units for outside corners, unless otherwise indicated.
- B. Concrete Masonry Units: ASTM C 90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
  2. Weight Classification: Normal weight.
  3. Curing: Allow masonry units to cure 28 days to permit drying shrinkage before laying.
  4. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
  5. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

- C. Special Masonry Units: Where indicated for chimney construction, provide units fabricated of 75 percent solid concrete masonry unit.
- D. Decorative Concrete Masonry Units: ASTM C 90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
  2. Weight Classification: Normal weight.
  3. Size (Width): Manufactured to dimensions specified in "Concrete Masonry Units" Paragraph above.
  4. Pattern and Texture: As indicated by product selection.
  5. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen.
    - a. Available Products:
      - 1) Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block.
  6. Available Products:
    - a. GENEST-MIRRA-TEX; GF-110 Pewter as manufactured by Genest Concrete, Sanford, Maine.
    - b. GENEST-PIERRATEX; GSB-110 Pewter as manufactured by Genest Concrete, Sanford, Maine.

## 2.4 MASONRY LINTELS

- A. Masonry Lintels: Built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Temporarily support built-in-place lintels until cured.

## 2.5 BRICK

- A. General: Provide shapes indicated and as follows:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
  3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
  4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: ASTM C 216, Grade SW, Type FBS.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 8000 psi.
  2. Initial Rate of Absorption: Less than 18 g/30 sq. in. per minute when tested per ASTM C 67.

3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
4. Sizes (Actual Dimensions):
  - a. Standard: 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long, unless noted otherwise.
  - b. Econo: 3-5/8 inches wide wide by 3-5/8 inches high by 7-5/8 inches long.
5. Application: Use where brick is exposed, unless otherwise indicated.
6. Products:
  - a. Brick Type 1: Camden Red Matt by Morin Brick Company; contact: Paul LaChance; phone: (207) 784-9375. Provide Econo size.
  - b. Brick, Type 2: Old Port All Darks by Morin Brick Company; contact: Paul LaChance; phone: (207) 784-9375. Provide standard size.

## 2.6 FIREPLACE AND CHIMNEY LINING UNITS

- A. Clay Flue Lining Units: ASTM C 315.

## 2.7 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.
  1. Blue Circle Cement, Inc.: Eaglebond High Strength Type "S".
  2. Ciment Quebec, Inc.: Portland and Lime / Type S.
  3. Dragon Cement and Concrete: Type S Masonry Cement.
- D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
  1. Available Products:
    - a. Davis Colors; True Tone Mortar Colors.
    - b. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.
- E. Aggregate for Mortar: ASTM C 144.
- F. Aggregate for Grout: ASTM C 404.
- G. Refractory Mortar Mix: Ground fireclay or non-water-soluble, calcium aluminate, medium-duty refractory mortar that passes ASTM C 199 test; or an equivalent product acceptable to authorities having jurisdiction.
- H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.
  1. Products: Subject to compliance with requirements, provide the following:

- a. ACM Chemistries; RainBloc for Mortar.
- b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
- c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.

I. Water: Potable.

## 2.8 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951.

- 1. Interior Walls: Mill- galvanized, carbon steel.
- 2. Exterior Walls: Hot-dip galvanized, carbon steel.
- 3. Wire Size for Side Rods: W1.7 or 0.148-inch diameter for interior walls and W2.8 or 0.188-inch diameter for exterior walls.
- 4. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
- 5. Wire Size for Veneer Ties: W1.7 or 0.148-inch diameter.
- 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
- 7. Provide in lengths of not less than 10 feet.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

1. Available Products:

- a. Dayton Superior Corporation, Dur-O-Wal Division; DA 320 Ladur.
- b. Hohmann & Barnard, Inc.; #200 Ladder-Mesh.
- c. Wire-Bond; Series 200, Single Wythe.

D. Masonry Joint Reinforcement for Multiwythe Masonry:

- 1. Adjustable (two-piece) type, ladder design, with one side rod at each face shell of backing wythe and with separate ties that extend into facing wythe. Ties have two hooks that engage eyes or slots in reinforcement and resist movement perpendicular to wall. Ties extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.
- 2. Available Products:
  - a. Duro-wall; D/A 360 Ladur-eye.
  - b. Hohmann & Barnard; Lox-All Adjustable Eye-Wire, #270.
  - c. Wire-Bond; Series 800, Composite Hook and Eye.

## 2.9 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with subparagraphs below, unless otherwise indicated.

- 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
1. Where wythes are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
  2. Wire: Fabricate from 3/16-inch- diameter, hot-dip galvanized steel wire.
- D. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section for Concrete: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.053-inch- thick, steel sheet, galvanized after fabrication.
  2. Available Products:
    - a. Duro-wall; D/A 100 with D/A 720-724
    - b. Heckman; #100 dovetail with 3/16 inch, #103 triangular tie.
    - c. Hohmann & Barnard; #305 with #315 tie.
    - d. Wire-Bond; Dovetail with #2102 triangle tie.
- E. Rigid Strap Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins, unless otherwise indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.
- F. Adjustable Masonry-Veneer Anchors
1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
    - a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
  2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
    - a. Anchor Section: Zinc-alloy barrel section with adjustable flanged head with eye and corrosion-resistant, self-drilling screw. Eye designed to receive wire tie and to serve as head for drilling fastener into framing. Barrel length to suit sheathing thickness, allowing screw to seat directly against framing with flanged head covering hole in sheathing.
    - b. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.188-inch-diameter, hot-dip galvanized steel wire.
    - c. Product:
      - 1) Heckmann Building Products Inc.; No. 77 Wing-Nut Pos-I-Tie.

## 2.10 MISCELLANEOUS ANCHORS

- A. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch, galvanized steel sheet.
- B. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.



- C. Postinstalled Anchors: Provide chemical or torque-controlled expansion anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
  - 1. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).

## 2.11 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Refer to Division 07 Section "Sheet Metal Flashing and Trim".
- B. Flexible Flashing: For flashing not exposed to the exterior, use the following, unless otherwise indicated:
  - 1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
    - a. Available Products:
      - 1) Advanced Building Products Inc.; Peel-N-Seal.
      - 2) Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
      - 3) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier-44.
      - 4) Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
      - 5) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
- C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

## 2.12 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.
  - 1. Holmann & Barnard: #NS – Closed Cell Neoprene.
  - 2. Wire Bond: 3000 Horizontal.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall.
- C. Weep/Vent Products: Use the following, unless otherwise indicated:
  - 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
    - a. Available Products:
      - 1) Advanced Building Products Inc.; Mortar Maze weep vent.
      - 2) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.

- 3) Heckmann Building Products Inc.; No. 85 Cell Vent.
  - 4) Hohmann & Barnard, Inc.; Quadro-Vent.
  - 5) Wire-Bond; Cell Vent.
- D. Cavity Drainage Material: 2-inch- thick, free-draining mesh; made from polyethylene strands and shaped to avoid being clogged by mortar droppings.
1. Available Products:
    - a. Mortar Net by Mortar Net USA, LTD.; Model MN10-2.
    - b. Mortar Break by Advanced Building Products; Mortar Break II.
- E. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.
1. Available Products:
    - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
    - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
    - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
    - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.
- F. Grout Screen: Monofilament screen fabricated from high-strength, non-corrosive, polypropylene polymers.
1. Available Products: Subject to compliance with requirements, grout screen materials that may be incorporated into the Work include, but are not limited to, the following:
    - a. AA3260; AA Wire Products.
    - b. Dur-O-Stop; Dur-O-Wal, Inc.
    - c. MGS; Hohmann and Barnard.

## 2.13 CAVITY-WALL INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, closed-cell product extruded with an integral skin. Provide 4 by 8 foot sheets with shiplapped edges, thickness as indicated on the drawings.
1. Available Products:
    - a. Dow Chemical Company; Cavitymate SC.
- B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

## 2.14 MASONRY CLEANERS

- A. Job-Mixed Detergent Solution: Solution of 1/2-cup dry measure tetrasodium polyphosphate (Spic and Span) and 1/2-cup dry measure laundry detergent dissolved in 1 gal. of water.
- B. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without

discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Available Manufacturers:
  - a. 202V Vana-Stop; Diedrich Technologies, Inc.
  - b. Sure Klean Vana Trol; ProSoCo, Inc.

## 2.15 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
  1. Do not use calcium chloride in mortar or grout.
  2. Limit cementitious materials in mortar to portland cement and lime.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide type S mortar for all applications stated unless another type is indicated.
- D. Water-Repellent Admixture: Provide for use with exterior ground face block veneer.
- E. Pigmented Mortar: Use select and proportion pigments with other ingredients to produce color required.
  1. Pigments shall not exceed 10 percent of Portland cement by weight.
  2. Mix to match Architect's sample. Allow for 1 bag mix.
  3. Allow for 3 color selections.
- F. Grout for Unit Masonry: Comply with ASTM C 476.
  1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
  2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
  1. Verify that foundations are within tolerances specified.
  2. Verify that reinforcing dowels are properly placed.
  3. Verify that built-in items are in proper location and ready for roughing into masonry work.
  4. Examine wall framing and sheathing to verify that stud locations are suitable for spacing of veneer anchors and that installation will result in a weatherproof covering.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
  - 1. Mix units from several pallets or cubes as they are placed.
- F. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
  - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
  - 3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
  - 5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
  - 6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
  - 7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.
- G. Bracing Walls During Construction: It is the sole responsibility of the masonry contractor to design and provide temporary bracing of masonry walls during construction. Refer to NCMA Tek Bulletin 3-4B and applicable OSHA standards. Provide 3' vinyl construction fencing around Restricted Zones.

### 3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
  - 1. At non-fire rated partitions, install compressible filler in joint between top of partition and underside of structure above.
  - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
  - 3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section "Fire-Resistive Joint Systems."

### 3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete masonry units as follows:
  - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
  - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
  - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units or brick with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.
- E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is necessary, remove mortar and replace.

### 3.5 CAVITY WALLS

- A. Bond wythes of cavity walls together using the following method:
  - 1. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
    - a. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement to allow for differential movement regardless of whether bed joints align.
- B. Keep cavities clean of mortar droppings and other materials during construction. Strike joints facing cavities flush.
  - 1. Install the specified cavity drainage material in thickness to fill the cavity above flashings as work progresses.
- C. Installing Cavity-Wall Insulation: At sheathing, place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. At masonry backup wall, fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
  - 1. Fill cracks and open gaps in insulation with foam insulation specified in Division 07 section "Thermal Insulation".

### 3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
  - 1. Space reinforcement not more than 16 inches o.c., unless noted otherwise.
  - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
  - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
    - a. Reinforcement above is in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
  - 1. At "T" intersection of walls, Strap Anchors may be used in lieu of masonry joint reinforcement. Install 16 inches on center.
- D. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### 3.7 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through insulation, air/vapor barrier, and sheathing to wall framing with metal fasteners of type indicated.
  2. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of cavity insulation.
  3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
  4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally, with not less than 1 anchor for each 1.77 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
- B. Anchor masonry veneers to structural masonry back-up wythe with wire ties designed to engage pintle-eye assembly incorporated in joint reinforcement.
1. Use individual adjustable metal ties installed in horizontal joints to bond wythes together. Provide ties shown, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally with not less than 1 anchor for each 1.77 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.
  2. Engage pintles form ties into eyes connected to joint reinforcement.
- C. Anchor masonry veneers to concrete backup wall with masonry-veneer anchors to comply with the following requirements:
1. Fasten each anchor section through air barrier system with tie indicated.
  2. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
  3. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally with not less than 1 anchor for each 1.77 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

### 3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control joints in unit masonry where indicated. Provide control joints in masonry partitions at changes in wall heights, at control joints in the wall bottom support material, within 8' of wall corners or intersections for walls greater than 16', and at not less than 24' on center for straight walls. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.
- B. Install control joints in veneer masonry as indicated on the drawings or, if not indicated, at a maximum spacing of 24 feet on center. Locate joints at door and window jambs inasmuch as possible.
1. Provide joints at both sides of windows and doors 6 foot wide or wider.
- C. Form control joints in concrete masonry as follows:
1. Install preformed control-joint gaskets designed to fit standard sash block.
  2. Joint reinforcement shall be discontinuous at control joints.
  3. Structural bond beam reinforcement shall be continuous through control joints.
- D. Form expansion joints in brick made from clay or shale as follows:
1. Build in compressible joint fillers and set back from face of veneer to form open joint 3/4 inch deep and not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

### 3.9 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

### 3.10 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents where indicated.
- B. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing as specified.
- C. Install flashing as follows, unless otherwise indicated:
  - 1. Install metal drip edges beneath flexible flashing at exterior face of wall.
  - 2. Extend flexible flashing down over vertical leg of metal flashing up a minimum of 8 inches and adhering to air barrier membrane. Apply termination bar and continuous bead of termination mastic along rubberized-asphalt flashing seams, cuts, and penetrations.
  - 3. At two-piece receiver and counter flashing furnished in Division 07 Section "Sheet Metal Flashing and Trim," install receiver in stepped fashion, providing proper weeping and drainage to exterior and pan below. Cover top of flashing with 12 inch wide cap strip of flexible flashing, adhering 8 inches to air/vapor barrier free of gaps and wrinkles, lapping 4 inches on to metal flashing, . Apply termination bar and continuous bead of termination mastic along rubberized-asphalt flashing seams, cuts, and penetrations.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
  - 1. Use specified weep/vent products to form weep holes.
  - 2. Space weep holes 24 inches o.c., unless otherwise indicated.
  - 3. Provide weep holes not more than 8 inches from end of lintels.
- F. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.
- G. Install vents in vertical head joints at the top of each continuous cavity. Use specified weep/vent product to form vents.
  - 1. Space vents 24 inches o.c.

### 3.11 CHIMNEY CONSTRUCTION

- A. Place first flue liner 8 inches above floor and supported along it's entire perimeter by masonry. Install clay flue liners to comply with ASTM C 1283. Install flue liners ahead of surrounding masonry. Set clay



flue liners in full bed of refractory mortar 1/16 to 1/8 inch thick. Strike joints flush on inside of flue to provide smooth surface. Maintain a minimum of 1/2 inch expansion space between flue liner and surrounding masonry except where surrounding masonry is required to provide lateral support for flue liners. Flue liner shall extend not less than 2 inches above the wash of chimney.

- B. Cleanout door shall be installed 16 inches to the bottom of door, above floor.
- C. Fill any space below the bottom of the flue liner with mortar or concrete.
- D. Place precast chimney cap atop chimney masonry; mortar into place; seal to protruding flue.

### 3.12 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  - 2. Limit height of vertical grout pours to not more than 60 inches.

### 3.13 INSTALLATION OF PRECAST CONCRETE

- A. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.

### 3.14 FIRESTOPPING

- A. Firestopping: Refer to Division 07 Section "Through-Penetration Firestop Systems" for installation requirements. Provide firestopping, as part of the work of this section, at the top of fire-rated masonry walls between top of partition and underside of structure above, both for new and existing conditions. Where gypsum wallboard is installed at the top of rated existing masonry walls, the firestopping will be provided by others.
  - 1. Bearing walls, not subject to vertical movement, may be grouted solid between top of wall and underside of structure, in lieu of firestopping.

## 3.15 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Reinforced Masonry Construction is subject to the IBC's Chapter 17 requirements for "Structural Tests and Special Inspections." Contractor shall fully cooperate with timely scheduling and accessibility for these required tests and inspections. See Structural Drawing S-000 for a Program and Schedule of all required tests and inspections.
1. Payment for these services will be made by Owner.
  2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
  3. A third inspection of Work failing to comply with specified requirements shall be done at Contractor's expense.
  4. Allow inspectors access to scaffolding and work areas, as needed to perform inspections. Place grout only after inspectors have formally accepted compliance of grout spaces and grades, sizes, and locations of reinforcement.
  5. Testing Frequency: One set of tests for each 5000 sq. ft of wall area or portion thereof.
  6. Mortar Test (Property Specification): For each mix provided, per ASTM C 780. Test mortar for compressive strength.
  7. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.

## 3.16 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  4. Protect metal roof and/or floor deck from contact with cleaner by covering with polyethylene film. Should damage occur to metal deck, repair damaged deck finish by re-priming steel deck materials or applying a ZRC coating to galvanized deck materials.
  5. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  6. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20 Revised, and manufacturer's printed instructions.
  7. Clean concrete masonry with job-mixed detergent solution by cleaning method indicated in NCMA TEK 8-2A and as applicable to type of stain on exposed surfaces.

## 3.17 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  - 1. Crush masonry waste to less than 4 inches in each dimension.
  - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 Section "Earth Moving."
  - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

## SECTION 051200 - STRUCTURAL STEEL FRAMING

## 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. Structural steel.
  - 2. Color galvanizing.
- B. Related Sections include the following:
  - 1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
  - 2. Division 01 Section "Sustainable Design Requirements."
  - 3. Division 05 Section "Steel Decking" for field installation of shear connectors.
  - 4. Division 05 Section "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other metal items not defined as structural steel.
  - 5. Division 09 painting Sections for surface preparation and priming requirements.

## 1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittal:
  - 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
  - 2. Credit MR 5.1 / 5.2: Product Data indicating location of material manufacturer for regionally manufactured materials.
    - a. Include statement indicating cost and distance from manufacturer to Project for each regional manufactured material.
- C. Submittal packages shall be complete and separated by Segment. A complete submittal shall include all Erection Drawings, all framing levels and all pieces for that Segment, such as column, beam and braces.

Submittal shall not be partial packages; for example just columns, just beams, etc. Stagger submittal packages between Segments by at least two weeks.

1. To expedite the review process, submit an early package of just Erection drawings showing complete size and layout of all pieces, and details of all field work required by the Erector to resolve any supplementary information before piece drawings are generated. Only upon acceptance of all layouts, including size and location of all framing at openings, shall piece drawings be submitted for review.
2. Shop Fabrication Drawings: Show fabrication of structural-steel components.
  - a. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
  - b. Include an early, separate embedment drawing package.
  - c. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show all welds in all locations – do not mark as typical.
  - d. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
  - e. For structural-steel connections, follow all typical and non-typical details shown on the Drawings. Provide the maximum rows of bolts for the depth of the beam at a 3" pitch in a standard double angle framed connection to the greatest extent possible. Single angle connections are unacceptable. End plates and shear tabs are only acceptable at skewed framing connections.

D. Welding certificates.

E. Qualification Data: For Installer, fabricator and professional engineer.

F. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Direct-tension indicators.
4. Tension-control, high-strength bolt-nut-washer assemblies.
5. Shear stud connectors.
6. Shop primers.

G. Source quality-control test reports.

H. Color Samples: Submit a color palette showing Manufacturer's standard colors available for Color Galvanizing for Architect's selection. Upon selection, submit two 3 inch by 6 inch samples of factory-applied coatings and colors proposed for use for approval prior to coating application.

## 1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, or who can demonstrate successful experience on three other projects of comparable size in the past 5 years.

B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, or who can demonstrate successful experience on three other projects of comparable size in the past 5 years.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

- D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- E. Comply with applicable provisions of the following specifications and documents:
  - 1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
  - 2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2."
  - 3. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
  - 4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
  - 5. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
  - 6. RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
  - 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

#### 1.7 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

### PART 2 - PRODUCTS

#### 2.1 STRUCTURAL STEEL MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel with postconsumer recycled content not less than 75 percent and preconsumer recycled content not less than 10 percent.
- B. W-Shapes: ASTM A 992/A 992M.
- C. Channels, Angles-Shapes: ASTM A 36/A 36M.
- D. Plate and Bar: ASTM A 36/A 36M.
- E. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B, structural tubing.
- F. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
- G. Welding Electrodes: Comply with AWS requirements.

## 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy hex steel structural bolts; ASTM A563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
  - 1. Finish: Plain.
  - 2. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type.
    - a. Finish: Plain.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A490, Type 1, heavy hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.
  - 1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type, plain.
- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
  - 1. Finish: Plain.
- D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- E. Anchor Rods: ASTM F 1554, Grade 36 or ASTM A 36/A 36M.
  - 1. Configuration: As detailed on the Drawings.
  - 2. Nuts: ASTM A 563 hex carbon steel.
  - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
  - 4. Washers: ASTM F 436 hardened carbon steel.
  - 5. Finish: Plain.
- F. Threaded Rods: ASTM A 36/A 36M.
  - 1. Nuts: ASTM A 563 hex carbon steel.
  - 2. Washers: ASTM A 36/A 36M carbon steel.
  - 3. Finish: Plain.
- G. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.

## 2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer.
- B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 or ASTM A 780.

## 2.4 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."

1. Camber structural-steel members where indicated.
  2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
  3. Mark and match-mark materials for field assembly.
  4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
  2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.5 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
  2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
  3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
    - a. Grind butt welds flush.
    - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.



## 2.6 SHOP PRIMING

- A. Shop prime all steel members except the following:
  - 1. Surfaces to be field welded.
  - 2. Surfaces to be high-strength bolted with slip-critical connections, such as at bracing connections.
  - 3. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits.
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
  - 2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Apply a 1-coat, non-asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

## 2.7 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.
  - 1. Fill vent holes and grind smooth after galvanizing.
  - 2. Galvanized lintels attached to structural-steel frame.
  - 3. All other structural steel members specified to be galvanized on the Drawings.

## 2.8 COLOR GALVANIZING

- A. For the purpose of establishing a standard of quality and performance, provide factory-applied metal coatings as specified by Duncan Galvanizing, 69 Norman Street, Everett, MA, 02149, telephone 617-389-8440, fax 617-389-2831, [www.duncangalvanizing.com](http://www.duncangalvanizing.com).
- B. Architectural Finish (where shown to be "Color Galvanized"): Provide factory-applied architectural coating over hot-dip galvanized steel, Colorgalv<sup>®</sup> by Duncan Galvanizing matching approved samples.
  - 1. Primer coat shall be factory-applied prime coating. Apply primer within 12 hours after galvanizing at the same facility where the galvanizing is done in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer.
  - 2. Finish coat shall be factory-applied high performance architectural finish. Apply finish coating at the galvanizer's plant, in a controlled environment meeting applicable environmental regulations and as recommended by the finish coating manufacturer.
  - 3. Coatings shall be certified VOC compliant and conform to applicable regulations and EPA standards.
  - 4. Apply the galvanizing, primer and coating within the same facility and provide single-source responsibility for galvanizing, priming and finish coating.
  - 5. Blast cleaning of the galvanized surface is not acceptable.
- C. Performance Criteria: Architectural Finish Coatings must meet or exceed the criteria:
  - 1. Primer:

- a. ABRASION - Method: ASTM D 4060 (CS17 Wheel, 1,000 grams load).
  - b. ADHESION - Method: ASTM D 3359, (Method B, 5 mm Crosshatch).
  - c. HUMIDITY - Method: ASTM D 4585
  - d. SALT SPRAY (FOG) - Method: ASTM B 117
2. Topcoat:
- a. ABRASION - Method: ASTM D 4060 (CS17 Wheel, 1,000 grams load).
  - b. ADHESION - Method: ASTM D 3359, (Method B, 5 mm Crosshatch).
  - c. GRAFFITI RESISTANCE - Method: The following graffiti materials applied to coating and allowed to dry for seven days: acrylic, epoxy-ester and alkyd spray paints, ballpoint ink, crayon, Markett marker, black shoe polish and lipstick.
  - d. EXTERIOR EXPOSURE - Method: Exposed at 45 degrees facing south
  - e. SURFACE BURNING CHARACTERISTICS: - Method: ASTM E-84
  - f. QUV - Method: ASTM G 53 (ES-40 bulbs, 4 hours light, 4 hours dark)
  - g. SALT SPRAY (FOG) - Method: ASTM B 117
  - h. FLEXIBILITY
  - i. PENCIL HARDNESS

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.
  - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

#### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings-- Allowable Stress Design and Plastic Design."
- B. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- C. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - 1. Level and plumb individual members of structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- D. Splice members only where indicated.
  - E. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
  - F. Do not use thermal cutting during erection.
  - G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
  - H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  1. Joint Type: Pretensioned.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
  1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
  2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
  3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
  4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
    - a. Grind butt welds flush.
    - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

### 3.5 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Steel Construction is subject to the IBC's Chapter 17 requirements for "Structural Tests and Special Inspections." Contractor shall fully cooperate with timely scheduling and accessibility for these required tests and inspections. See Structural Drawing S-000 for a Program and Schedule of all required tests and inspections.
  1. Payment for these services will be made by Owner.
  2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

3. A third inspection of Work failing to comply with specified requirements shall be done at Contractor's expense.
  4. Allow inspectors access to scaffolding and work areas, as needed to perform inspections. Provide lifts as needed to perform inspections.
  5. Contractor shall schedule testing and inspections and 48 hours in advance of scheduled concrete delivery.
  6. Contractor shall not place any concrete encasing metal deck, shear studs, column base plates, or any other structural item until an Inspection has been made and the Work to be encased has been formally accepted.
- B. Work will be subject to the following inspections, including but not limited to:
1. Bolted Connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
  2. Welded Connections will be visually inspected according to AWS D1.1.
    - a. Lateral force resisting beam to column moment connection field welds will be tested according to AWS D1.1 and Ultrasonic Inspection, ASTM E 164.
  3. In addition to visual inspection, field-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:
    - a. Bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
    - b. Tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
- C. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

### 3.6 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.
- C. Color Galvanized Surfaces: For damaged and field-welded metal coated surfaces, clean welds, bolted connections and abraded areas.
1. For factory-applied finish coatings, the applicator shall be responsible for field-touch-up for up to 1 percent of the surface area at no additional expense to the Owner. Provide touch-up such that repair is not visible from a distance of 6 feet.
  2. A touch-up repair kit or touchup instructions shall be provided to the Owner for each type of factory-applied finish.

END OF SECTION 051200

## SECTION 052100 - STEEL JOIST FRAMING

## 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. K-series steel joists.
  - 2. Long-span steel joists.
  - 3. Joist accessories
  - 4. Any non-typical requirements explicitly detailed on the Drawings.
- B. Related Sections include the following:
  - 1. Division 01 Section "Sustainable Design Requirements."
  - 2. Division 03 Section "Cast-in-Place Concrete."
  - 3. Division 04 Section "Unit Masonry."
  - 4. Division 05 Section "Structural Steel."

## 1.3 DEFINITIONS

- A. SJI "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists requiring modification by manufacturer to support non-uniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

## 1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
- B. Design all joists for uplift requirements as specified on the Drawings.
- C. Design special joists to withstand design loads with live load deflections no greater than the following:
  - 1. Roof Joists: Vertical deflection of 1/360 of the span under snow load alone and 1/240 of the span under total load (dead plus snow load).

## 1.5 SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product indicated.
- B. LEED Submittal:

1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
  - C. Shop Drawings: Show layout, designation, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, joist accessories; splice and connection locations and details; and attachments to other construction.
    1. Indicate locations and details of bearing plates to be embedded in other construction.
    2. Comprehensive engineering analysis of special joists signed and sealed by a professional engineer licensed in the State of Maine responsible for its preparation.
  - D. Welding certificates.
  - E. Manufacturer Certificates: Signed by manufacturers certifying that joists comply with requirements.
  - F. Mill Certificates: Signed by bolt manufacturers certifying that bolts comply with requirements.
  - G. Qualification Data: For manufacturer and professional engineer.
  - H. Field quality-control test and inspection reports.
  - I. Research/Evaluation Reports: For joists.
- 1.6 QUALITY ASSURANCE
- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables of SJI "Specifications."
    1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
  - B. SJI Specifications: Comply with standard specifications in SJI's "Specifications" that are applicable to types of joists indicated.
  - C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
  - B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.
- 1.8 SEQUENCING
- A. Coordinate all required connections to structural steel framing for the permanent construction as well as for OSHA compliant erection safety, including but not limited to drill holes, gusset plates, erection stabilizer plates, sloped joist bearing seat depths, width and length.

## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Steel: Comply with SJI's "Specifications" for web and steel-angle chord members.
  - 1. Recycled Content: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 75 percent.
- B. Steel Bearing Plates: ASTM A 36/A 36M.
- C. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
  - 1. Finish: Plain, uncoated.
- D. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
  - 1. Finish: Plain.
- E. Welding Electrodes: Comply with AWS standards.
- F. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 or ASTM A 780.

## 2.2 PRIMERS

- A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
- B. Primer: Provide shop primer that complies with Division 09 painting Sections.

## 2.3 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
  - 1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.
- D. Provide holes in chord members for connecting and securing other construction to joists.
- E. Top-Chord Extensions: Extend top chords of joists with SJI's Type "R12" top-chord extensions where indicated, complying with SJI's "Specifications."

- F. Camber joists according to SJI's "Specifications."
- G. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

#### 2.4 LONG-SPAN STEEL JOISTS

- A. Manufacture steel joists according to "Standard Specifications for Long-span Steel Joists, LH-Series and Deep Long-span Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated.
  - 1. Joist Type: LH-series steel joists and DLH-series steel joists.
  - 2. End Arrangement: Under-slung.
  - 3. Top-Chord Arrangement: As indicated on the Drawings.
- B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Camber long-span steel joists according to SJI's "Specifications."
- E. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

#### 2.5 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Bridging: Fabricate as indicated and according to SJI's "Specifications." Furnish additional erection bridging if required for stability.
- C. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

#### 2.6 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Apply 1 coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.
- C. Shop priming of joists and joist accessories is specified in Division 09 painting Sections.



## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
  - 1. Before installation, splice joists delivered to Project site in more than one piece.
  - 2. Space, adjust, and align joists accurately in location before permanently fastening.
  - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
  - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads have been applied.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts.
- E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

## 3.3 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Steel Construction is subject to the IBC's Chapter 17 requirements for "Structural Tests and Special Inspections." Contractor shall fully cooperate with timely scheduling and accessibility for these required tests and inspections. See Structural Drawing S-000 for a Program and Schedule of all required tests and inspections.
  - 1. Payment for these services will be made by Owner.
  - 2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
  - 3. A third inspection of Work failing to comply with specified requirements shall be done at Contractor's expense.
  - 4. Allow inspectors access to scaffolding and work areas, as needed to perform inspections. Provide lifts as needed to perform inspections.

5. Contractor shall schedule testing and inspections and 48 hours in advance of scheduled concrete delivery.
  6. Contractor shall not place any concrete encasing metal deck, shear studs, column base plates, or any other structural item until an Inspection has been made and the Work to be encased has been formally accepted.
- B. Work will be subject to the following inspections, including but not limited to:
1. Bolted Connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
  2. Welded Connections will be visually inspected according to AWS D1.1.
    - a. Lateral force resisting beam to column moment connection field welds will be tested according to AWS D1.1 and Ultrasonic Inspection, ASTM E 164.
- C. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

#### 3.4 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
  2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.
- D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 052100

## SECTION 053100 - STEEL DECKING

## 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. Roof deck.
  - 2. Acoustical roof deck.
  - 3. Composite steel floor deck.
  - 4. All deck accessories as specified herein and as detailed on the Drawings.
- B. Related Sections include the following:
  - 1. Division 01 Section "Sustainable Design Requirements."
  - 2. Division 03 Section "Cast-in-Place Concrete."
  - 3. Division 05 Section "Structural Steel Framing."
  - 4. Division 09 painting Sections for repair painting of primed deck.

## 1.3 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. LEED Submittal:
  - 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
  - 2. Credit MR 5.1 / 5.2: Product Data indicating location of material manufacturer for regionally manufactured materials.
    - a. Include statement indicating cost and distance from manufacturer to Project for each regional manufactured material.
- C. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
- D. Product Certificates: For each type of steel deck, signed by product manufacturer.
- E. Field quality-control test and inspection reports.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
  - 1. Power-actuated mechanical fasteners.
  - 2. Acoustical roof deck including NRC.

#### 1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- B. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those 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 of applicable testing and inspecting agency.
  - 2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.
- C. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- D. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
  - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

#### 1.6 COORDINATION

- A. Coordinate installation of sound-absorbing insulation strips in topside ribs of acoustical deck with roofing installation specified in Division 07 to ensure protection of insulation strips against damage from effects of weather and other causes.

### PART 2 - PRODUCTS

- 2.1 Recycled Content: Provide products with an average recycled content of steel products so post-consumer recycled content is not less than (50%) fifty percent and pre-consumer recycled content is not less than (5%) five percent.

#### 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Steel Deck:
    - a. Canam Steel Corp.;The Canam Manac Group.
    - b. Nucor Corp.; Vulcraft Division.
    - c. United Steel Deck, Inc.
    - d. Approved equal.

### 2.3 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
  2. Deck Profile: As indicated.
  3. Profile Depth: As indicated.
  4. Design Uncoated-Steel Thickness: As indicated.
  5. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated.
  6. Span Condition: Triple span or more.
  7. Side Laps: Overlapped.

### 2.4 ACOUSTICAL ROOF DECK

- A. Acoustical Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
    - a. Color: Manufacturer's standard.
  2. Deck Profile: As indicated.
  3. Profile Depth: As indicated.
  4. Design Uncoated-Steel Thickness: As indicated.
  5. Span Condition: Triple span or more.
  6. Side Laps: Interlocking.
  7. Acoustical Perforations: Cellular deck units with manufacturer's standard perforated flat-bottom plate welded to ribbed deck.
  8. Sound-Absorbing Insulation: Manufacturer's standard premolded roll or strip of glass or mineral fiber.
    - a. Factory install sound-absorbing insulation into cells of cellular deck.
  9. Acoustical Performance: NRC **0.80**, tested according to ASTM C 423. Note to bidders: Canam's deck catalogue 03/2005 does not meet this requirement.

### 2.5 COMPOSITE FLOOR DECK

- A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
  2. Profile Depth: As indicated.
  3. Design Uncoated-Steel Thickness: As indicated.
  4. Span Condition: Triple span or more.
  5. Provide integral hanger tabs capable of supporting an allowable load of 100 lbs per tab.

## 2.6 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
  - 1. Roof deck finish (edge) strips, butt strips, and other plate material as specified on the Drawings.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 30 for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- H. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- I. Galvanizing Repair Paint: ASTM A 780 or SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.
- J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

### 3.2 INSTALLATION, SPECIAL

- A. The underside of roof and floor deck is exposed to view in the finished state in various places throughout the Buildings. Special care shall be taken when installing deck in these places to provide a neat, aesthetic appearance and to avoid welding that burns through the edge of a bearing. Excessive burn marks and disorderly Work as deemed by the Architect will require corrective work at the Contractor's expense. See Reflected Ceiling plans for extent.

### 3.3 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
  - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions. Mechanical fasteners are recommended for use where the underside of Acoustic Roof Deck is exposed to view in the finished state. Submit proposed fasteners including load data (shear and withdrawal) for review and approval before using.

### 3.4 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
  - 1. Weld Diameter: 5/8 inch, nominal.
  - 2. See above for mechanical fastening recommendation.
  - 3. Fastener Spacing: Fasten edge and interior ribs of deck units with a minimum of two fasteners per deck unit at each support. Space fasteners 12 inches apart in the field of roof and 6 inches apart in roof corners and perimeter (both end and edge of roof deck), based on roof-area definitions in FMG Loss Prevention Data Sheet 1-28.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18 inches, and as follows:
  - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
  - 1. End Joints: Lapped 2 inches minimum.

- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.
  - 1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish (edge) strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.
  - 1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

### 3.5 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
  - 1. Weld Diameter: 5/8 inch, nominal.
  - 2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart. Install welds in "weak" side of deck flute such that Shear Connectors may be installed in "strong" side of flute as required. See Typical Detail on Structural Drawing S-400 for this requirement.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as follows:
  - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
  - 2. Mechanically clinch or button punch.
  - 3. Fasten with a minimum of 1-1/2-inch- long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2", with end joints as follows:
  - 1. End Joints: Butted.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

### 3.6 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Steel Construction is subject to the IBC's Chapter 17 requirements for "Structural Tests and Special Inspections." Contractor shall fully cooperate with timely scheduling and accessibility for these required tests and inspections. See Structural Drawing S-000 for a Program and Schedule of all required tests and inspections.
  - 1. Payment for these services will be made by Owner.



2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
  3. A third inspection of Work failing to comply with specified requirements shall be done at Contractor's expense.
  4. Allow inspectors access to scaffolding and work areas, as needed to perform inspections. Provide lifts as needed to perform inspections.
  5. Contractor shall schedule testing and inspections and 48 hours in advance of scheduled concrete delivery.
  6. Contractor shall not place any concrete encasing metal deck, shear studs, column base plates, or any other structural item until an Inspection has been made and the Work to be encased has been formally accepted.
- B. Work will be subject to the following inspections, including but not limited to:
1. Side-lap fastener size and spacing.
  2. Welded Connections will be visually inspected according to AWS D1.1.
- C. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

### 3.7 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Division 09.
- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

## SECTION 054000 - COLD-FORMED METAL FRAMING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The work of this Section, as well as Sections 092216 and 092900, will be provided as a Filed Sub Bid.

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Wall and fascia framing.
  - 2. Interior load-bearing wall framing, including seismic flat strap bracing.
  - 3. Ceiling and/or exterior soffit joist framing.
  - 4. Floor framing for Mechanical Room #235.
  - 5. Refer to Structural Drawings for typical anchorage and load path requirements to the primary structure, as well as any special framing conditions.
- B. Related Sections include the following:
  - 1. Division 01 Section "Sustainable Design Requirements."
  - 2. Division 05 Section "Metal Fabrications" for masonry shelf angles and connections.
  - 3. Division 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
  - 4. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
  - 5. Division 23 Section "Solar Wall Panels."

## 1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated. Provide minimum depths, gages, flange widths and spacings at salient building corners as required in this Specification or on the Drawings, regardless of design computations.
  - 1. Design Loads: Per Chapter 16 of the 2006 IBC and ASCE 7-05. See Structural General Notes for all required design data, including but not limited to floor live loads, exposure, thermal and importance factors. Dead loads shall include the self weight of all materials plus an additional 5 psf miscellaneous superimposed dead load. Engineer flat-strap bracing on surrounding walls of Mechanical Room #235 for Seismic.
    - a. Special design condition: Coordinate required attachment (snow and wind) loads for support of Solar Wall Panels to be provided and installed under Division 23. Provide and engineer built-up studs to support required forces and anchorage.
    - b. Special design condition: Engineer exterior wall studs on "AE" line between "A2" and "A3" lines for additional axial live load of 200 lb with an assumed eccentricity of 6" for future climbing wall (not in contract). Provide studs at 12" o/c and solid wall blocking at 4'-0" o/c minimum.

2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
    - a. Exterior Wall Framing: Horizontal deflection of 1/600 of the wall height where backing up Brick Veneer, otherwise L/360.
    - b. Floor Framing: Horizontal deflection of 1/360 of the span.
    - c. Ceiling / Soffit Joist Framing: Vertical deflection of 1/360 of the span.
  3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
  4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
    - a. Upward and downward movement of 3/4 inch.
- B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
  2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. LEED Submittal:
  1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
  2. Credit MR 5.1 / 5.2: Product Data indicating location of material manufacturer for regionally manufactured materials.
    - a. Include statement indicating cost and distance from manufacturer to Project for each regional manufactured material.
- C. Shop Drawings: Show complete layout of studs, jambs and headers for all exterior walls on 1/4" = 1'-0" scale Wall Framing Elevations in their entirety, including but not limited to spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work. Shop drawing submittals without entire wall framing elevations are unacceptable and will not be reviewed. Architect's review includes but is not limited to suitability of the submittal for construction, inspection and as an Owner's record.
  1. For cold-formed metal framing indicated to comply with design loads, submit structural analysis calculations signed and sealed by the qualified professional engineer responsible for their preparation. The Engineer shall also sign and seal each shop drawing. Review of structural analysis calculations is for general conformance with requirements, completeness and assumed load path back to the primary structure. The responsibility for correctness rests solely with the

design professional. The Architect reserves the authority to require resubmittal for observed deficiencies, or incompleteness. Calculations and Shop Drawings must be submitted together in the same submittal package for concurrent review.

2. Nomenclature: Use Steel Stud Manufacturer Association (SSMA) four part identification code which identifies the size (both depth and flange width), style and material thickness of each member. Shop drawings without this nomenclature are unacceptable and will not be reviewed.
- D. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
1. Steel sheet.
  2. Expansion anchors.
  3. Power-actuated anchors.
  4. Mechanical fasteners.
  5. Vertical deflection clips.
  6. Horizontal drift deflection clips
  7. Miscellaneous structural clips and accessories.
- E. Research/Evaluation Reports: For cold-formed metal framing.
- F. Special Inspection Field Reports: The professional engineer responsible for the design shall schedule at least FIVE site visits and submit inspection field reports bearing his/her seal, including a final affidavit after the construction is complete and inspected stating that the Work is complete and is in accordance with all requirements.

#### 1.5 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a professional engineer licensed in the State of Maine.
- B. Professional Engineer Qualifications: A professional engineer who is licensed to practice in the State of Maine and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- D. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- E. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:
  - 1. Allied Studco.
  - 2. AllSteel Products, Inc.
  - 3. California Expanded Metal Products Company.
  - 4. Clark Steel Framing.
  - 5. Consolidated Fabricators Corp.; Building Products Division.
  - 6. Craco Metals Manufacturing, LLC.
  - 7. Custom Stud, Inc.
  - 8. Dale/Incor.
  - 9. Design Shapes in Steel.
  - 10. Dietrich Metal Framing; a Worthington Industries Company.
  - 11. Formetal Co. Inc. (The).
  - 12. Innovative Steel Systems.
  - 13. MarinoWare; a division of Ware Industries.
  - 14. Quail Run Building Materials, Inc.
  - 15. SCAFCO Corporation.
  - 16. Southeastern Stud & Components, Inc.
  - 17. Steel Construction Systems.
  - 18. Steeler, Inc.
  - 19. Super Stud Building Products, Inc.
  - 20. United Metal Products, Inc.
  - 21. Approved equal, with an ICC report submittal.

## 2.2 MATERIALS

- A. Recycled Content: Provide products with an average recycled content of steel products so post-consumer recycled content is not less than (25%) twenty-five percent and pre-consumer recycled content is not less than (5%) five percent.
- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
  - 1. Grade: As required by structural performance.
  - 2. Coating: G60, A60, AZ50, or GF30.

- C. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
  - 1. Grade: As required by structural performance.
  - 2. Coating: G60 minimum.

### 2.3 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0428 inch.
  - 2. Flange Width: 2.0 inches minimum.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: Matching steel studs.
  - 2. Flange Width: 1-1/4 inches minimum.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0428 inch.
  - 2. Flange Width: 2.0 inches.
- D. Steel Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0428 inch.
  - 2. Top Flange Width: 2.0 inches.
- E. Flat strap bracing and gusset plates for Seismic loads: Width and thickness as required per design requirements.

### 2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.054 inch.
  - 2. Minimum Flange Width: 2.0 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: Matching steel studs.
  - 2. Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

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. Dietrich Metal Framing; a Worthington Industries Company.
    - b. MarinoWare, a division of Ware Industries.
    - c. SCAFCO Corporation
    - d. The Steel Network, Inc.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
1. Minimum Base-Metal Thickness: 0.0538 inch.
  2. Flange Width: 1 inch plus the design gap for 1-story structures.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
    - a. Minimum Base-Metal Thickness: 0.0428 inch.
    - b. Flange Width: 1 inch plus the design gap for 1-story structures.
  2. Inner Track: Of web depth indicated, and as follows:
    - a. Minimum Base-Metal Thickness: 0.0428 inch.
    - b. Flange Width: 2.5"
- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.

## 2.5 FLOOR JOIST FRAMING

- A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0538 inch.
  2. Flange Width: 2 inches minimum.
- B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges.

## 2.6 CEILING / EXTERIOR SOFFIT JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with enlarged service holes, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch.
  2. Flange Width: 2.0 inches, minimum.

## 2.7 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
  - 1. Supplementary framing.
  - 2. Bracing, bridging, and solid blocking.
  - 3. Web stiffeners.
  - 4. Anchor clips.
  - 5. End clips.
  - 6. Foundation clips.
  - 7. Gusset plates.
  - 8. Stud kickers, knee braces, and girts.
  - 9. Joist hangers and end closures.
  - 10. Hole reinforcing plates.
  - 11. Backer plates.

## 2.8 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C or mechanically deposition according to ASTM B 695, Class 50.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

## 2.9 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035 or ASTM A 780.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.



- D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

## 2.10 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
  - 1. Fabricate framing assemblies using jigs or templates.
  - 2. Cut framing members by sawing or shearing; do not torch cut.
  - 3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
  - 4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
  - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
  - 2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

- B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

### 3.3 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
  - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are detailed for track or tension members. In nested, built-up jambs taller than 10'-0", track sections shall be neglected in the calculation for strength and stiffness.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
  - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.4 LOAD-BEARING WALL INSTALLATION

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
  - 1. Anchor Spacing: To match stud spacing.
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows regardless of design computations:
  - 1. Stud Spacing: 16 inches maximum, except 12 inches maximum within salient building corners ("a" distance per Figure 6-3 of ASCE 7-05).
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
  - 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
  - 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
  - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced as indicated on Shop Drawings. Fasten at each stud intersection.
  - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches deep.
  - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  - 3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

- J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.
- L. At walls acting as base curb bearing walls for skylights, provide a continuous metal tension strap on outside face of top track designed and detailed to resist a tensile force of 5,000 lbs.

### 3.5 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to track, unless otherwise indicated. Space studs as follows regardless of design computations:
  - 1. Stud Spacing: 16 inches maximum, except 12 inches maximum within salient building corners ("a" distance per Figure 6-3 of ASCE 7-05).
- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  - 1. Install single-leg deflection tracks and anchor to building structure.
  - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
  - 3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
  - 4. Connect drift clips to cold formed metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
  - 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
    - a. Install solid blocking at centers indicated on Shop Drawings.
  - 2. Bridging: At Contractor's option:
    - a. Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
    - b. Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
    - c. Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

- G. Install horizontal support of safin insulation where indicated at exterior wall framing. Provide stud-track solid blocking of width and thickness to match studs.
- H. Design and detail continuous box header base curb to support the weight of the wall above with a maximum deflection of  $L/600$  as shown F12/S-401 (“CC.4” and “CD.6” lines on S-108).

### 3.6 JOIST INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
  - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
  - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
  - 1. Joist Spacing: As indicated.
- D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.
  - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at midspan. Fasten bridging at each joist intersection as follows:
  - 1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
  - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

### 3.7 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Contractor’s design engineer shall include special inspection services to perform field inspections and prepare test reports. Contractor shall fully cooperate with timely scheduling and accessibility for these required tests and inspections.
  - 1. Payment for these services shall be included in the Contractor’s base bid.
  - 2. A minimum of FIVE site visits are required.
  - 3. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

4. Allow inspectors access to scaffolding and work areas, as needed to perform inspections. Provide lifts as needed to perform inspections.
  5. Contractor shall schedule testing and inspections and 48 hours in advance of installing any sheathing.
  6. Contractor shall not conceal any structural item until an Inspection has been made and the Work to be encased has been formally accepted.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

### 3.8 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

## SECTION 055000 - METAL FABRICATIONS

## 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. Steel framing and supports for operable partitions.
2. Steel framing and supports for overhead doors.
3. Steel framing and supports for mechanical and electrical equipment.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Elevator machine beams.
6. Support angles for elevator door sills.
7. Loose bearing and leveling plates.
8. Steel weld plates and angles for casting into concrete not specified in other Sections.
9. Metal ladders.
10. Metal ships' ladders.
11. Metal bollards.
12. Installation of Stage Lighting Bar.
13. Uni-Strut support system.
14. Providing and installing lateral restraint at tops of all interior CMU partition walls per Structural General Note, "CMU Partition Walls and Steel Restraints" on S-001 and "Typical CMU Wall Lateral Restraints" as detailed on F1/S-400.

- B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

- C. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, wedge-type inserts and other items indicated to be cast into concrete.
2. Division 04 Section "Unit Masonry" for installing loose lintels, anchor bolts, and other items indicated to be built into unit masonry.
3. Division 05 Section "Structural Steel Framing."
4. Division 05 Section "Metal Stairs" for stairs, handrails and guards.
5. Division 06 Section "Rough Carpentry" for metal framing anchors.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
  - 1. Provide ladders meeting the OSHA requirements of 29CFR 1910.27.
- B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
  - 2. Metal nosings.
  - 3. Paint products.
  - 4. Grout.
- B. LEED Submittal:
  - 1. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
  - 2. Credit MR 5.1: Product Data indicating location of material manufacturer for regionally manufactured materials.
    - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.
    - b. Include statement indicating cost and distance from point of extraction, harvest, or recovery to Project for each raw material used in regionally manufactured materials.
- C. Shop Drawings: Show fabrication and installation details for metal fabrications.
  - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
  - 2. Provide templates for anchors and bolts specified for installation under other Sections.
  - 3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 4. Submit layout plan for restraint of interior CMU partition walls including details for all typical and special conditions.
- D. Welding certificates.



## 1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."
  - 2. AWS D1.3, "Structural Welding Code--Sheet Steel."

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
  - 2. Provide allowance for trimming and fitting at site.

## 1.7 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

### 2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

### 2.3 FERROUS METALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- D. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- E. Slotted Channel Framing: Cold-formed metal channels with flange edges returned toward web and with 9/16-inch- wide slotted holes in webs at 2 inches o.c.
  - 1. Depth of Channels: As indicated or as required to support materials.
  - 2. Metal and Thickness: Galvanized steel complying with ASTM A 653/A 653M, structural quality, Grade 33, with G90 coating; thickness as required to support materials.
  - 3. Finish: Rust-inhibitive, baked-on, acrylic enamel.
- F. Gray-Iron Castings: ASTM A 48, Class 30, unless another class is indicated or required by structural loads.

### 2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.
- D. Anchor Bolts: ASTM F 1554, Grade 36.
  - 1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.
- E. Eyebolts: ASTM A 489.
- F. Machine Screws: ASME B18.6.3.
- G. Lag Bolts: ASME B18.2.1.
- H. Wood Screws: Flat head, ASME B18.6.1.
- I. Plain Washers: Round, ASME B18.22.1.
- J. Lock Washers: Helical, spring type, ASME B18.21.1.

- K. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
- L. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
  - 2. Material for Anchors in Exterior Locations: Alloy Group 1 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
  - 1. Available Products:
    - a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19.
    - b. ICI Devoe Coatings; Catha-Coat 313.
    - c. International Coatings Limited; Interzinc 315 Epoxy Zinc-Rich Primer.
    - d. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.
    - e. Sherwin-Williams Company (The); Corothane I GalvaPac Zinc Primer.
    - f. Tnemec Company, Inc.; Tneme-Zinc 90-97.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
  - 1. Available Products:
    - a. Sealmatic, Type 1; W. R. Meadows
    - b. Hydrocide 600; Sonneborn Building Products.
    - c. Karnak 100 AF; Karnac Chemical Corp.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
  - 1. Available Products:

- a. Five Star Grout by Five Star Products, Inc.
- b. Masterflow 928 Grout by Master Builders Technologies.
- c. SonogROUT 10K by Sonneborn.
- d. 14K Hy Flow by Sonneborn.

- G. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

## 2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

## 2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
  - 1. Fabricate units from slotted channel framing where indicated.
  - 2. Furnish inserts if units are installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Galvanize miscellaneous framing and supports where indicated.

## 2.8 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel L-shapes and WT-shapes of size indicated on the Structural Drawings (S-001) for openings and recesses in masonry veneer at locations indicated throughout the Architectural Drawings. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 8 inches.
- C. Galvanize loose steel lintels located in exterior walls.

## 2.9 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Prime plates with zinc-rich primer.

## 2.10 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

## 2.11 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior loading dock angles and other steel trim indicated to be galvanized.

## 2.12 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, unless otherwise indicated.
2. For elevator pit ladders, comply with ASME A17.1.

B. Fabricate ladders from materials as detailed on the drawings or if not indicated, as follows:

1. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges, spaced 18 inches .
2. Rungs: 3/4-inch- diameter steel bars, spaced 12 inches.
3. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
4. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Available Products:
  - a. IKG Industries, a Harsco company; Mebac.
  - b. W. S. Molnar Company; SlipNOT.
7. Galvanize exterior ladders, including brackets and fasteners.
8. Prime elevator pit ladders, including brackets and fasteners, with zinc-rich primer.
9. Prime interior ladders.

## 2.13 METAL SHIPS' LADDERS

A. Provide metal ships' ladders where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Fabricate ships' ladders, including railings from steel.
2. Fabricate treads from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 1/2 inch in least dimension.
3. Comply with applicable railing requirements in Division 05 Section "Metal Stairs."

B. Prime steel ships' ladders, including treads, railings, brackets, and fasteners, with zinc-rich primer.

## 2.14 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

## 2.15 ABRASIVE METAL NOSINGS

- A. Cast-Metal Units: Cast aluminum, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Safety Tread Co., Inc.
    - b. Balco Inc.
    - c. Barry Pattern & Foundry Co., Inc.
    - d. Granite State Casting Co.
    - e. Safe-T-Metal Company, Inc.
    - f. Wooster Products Inc.
  2. Nosings: Cross-hatched units, 4 inches wide with 1/4-inch lip, for casting into concrete steps.
- B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- C. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches from ends and not more than 12 inches o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.
- D. Apply bituminous paint to concealed surfaces of cast-metal units.

## 2.16 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

## 2.17 STEEL AND IRON FINISHES

- A. Galvanizing: Provide coating for iron and steel fabrications applied by the hot-dipped process, Durogalv by Duncan Galvanizing. The galvanizing bath shall contain high grade zinc and other earthly materials. Immediately before galvanizing, the steel shall be immersed in a bath of zinc ammonium chloride. The use of the wet kettle process is prohibited. Comply with ASTM A123 for fabricated products and ASTM A 153 for hardware. Provide thickness of galvanizing specified in referenced standards. The galvanizing bath shall contain high grade zinc, nickel, and other earthly materials.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless

otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

#### 3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
  1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install Stage Lighting Bar by suspending at heights indicated with steel cables spaced to support load, but do not exceed 6 feet o.c. between cables.



### 3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
  - 1. Use nonshrink grout, nonmetallic, in concealed and exposed locations, unless otherwise indicated.
  - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.4 INSTALLING METAL BOLLARDS

- A. Fill bollards solidly with concrete, mounding top surface to shed water.

### 3.5 INSTALLING NOSINGS

- A. Install with anchorage system indicated to comply with manufacturer's written instructions.
- B. Center nosings on tread widths.
- C. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

### 3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

## SECTION 055100 - METAL STAIRS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Preassembled steel stairs with concrete-filled treads.
  - 2. Steel tube railings attached to metal stairs and ships ladders.
  - 3. Steel tube handrails attached to walls adjacent to metal stairs.
  - 4. Exterior aluminum pipe and tube railings.
  - 5. Folding stairway.
- B. Related Sections include the following:
  - 1. Division 03 Section "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
  - 2. Division 04 Section "Unit Masonry" for beam pockets and bearing plates.
  - 3. Division 06 Section "Rough Carpentry" for wood blocking for anchoring railings.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Stairs: Provide metal stairs capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Uniform Load: 100 lbf/sq. ft..
  - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
  - 3. Uniform and concentrated loads need not be assumed to act concurrently.
  - 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
  - 5. Limit deflection of treads, platforms, and framing members to  $L/360$  or 1/4 inch, whichever is less.
- B. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Top Rails of Guards:

- a. Uniform load of 50 lbf/ ft. applied in any direction.
  - b. Concentrated load of 200 lbf applied in any direction.
  - c. Uniform and concentrated loads need not be assumed to act concurrently.
3. Infill of Guards:
- a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
  - b. Uniform load of 25 lbf/sq. ft. applied horizontally.
  - c. Infill load and other loads need not be assumed to act concurrently.
- C. Seismic Performance: Stair framing shall be detailed to be pocketed into reinforced CMU shaft walls which shall be relied on to resist 100% of the seismic load.

#### 1.4 SUBMITTALS

##### A. LEED Submittal:

1. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
  - a. Include statement indicating costs for each product having recycled content.
2. Credit MR 5.1: Product Data indicating location of material manufacturer for regionally manufactured materials.
  - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.
  - b. Include statement indicating cost and distance from point of extraction, harvest, or recovery to Project for each raw material used in regionally manufactured materials.

##### B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Calculations for all typical and special conditions indicating compliance with the Performance Requirements above shall be accompany Shop Drawings in the same Submittal package for concurrent review.

1. Provide templates for anchors and bolts specified for installation under other Sections.
2. Provide size, layout and elevations for beam pockets and bearing plates to be provided and installed by the Mason. This submittal shall be made in a timely manner to allow coordination and scheduling of the Mason's work.
3. Each Shop Drawing shall be signed and sealed by the qualified professional engineer responsible for the preparation of the Calculations. Shop Drawings not bearing the seal and signature will not be accepted.

##### C. Welding certificates.

#### 1.5 QUALITY ASSURANCE

##### A. Installer Qualifications: Fabricator of products.

##### B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

1. Preassembled Stairs: Commercial class.
- C. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
  2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  3. AWS D1.3, "Structural Welding Code--Sheet Steel."
- D. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.
1. Stairs and Handrails: Provide stairs and handrails as required by accessibility regulations and requirements of authorities having jurisdiction. These include, but are not limited to, the following:
    - a. Treads and Risers:
      - 1) Provide treads with uniform riser heights and tread widths.
      - 2) Provide no less than 11 inch (275 mm) tread width.
    - b. Nosings:
      - 1) Provide the radius of curvature at the leading edge of the tread of not greater than 1/2 inch (13 mm).
      - 2) Provide sloped risers or the angle on the underside of the nosing will not be less than 60 degrees from the horizontal.
      - 3) Project nosings not more than 1-1/2 inch.
    - c. Size and Spacing of Handrails:
      - 1) Handrail Diameter: 1-1/4 to 1-1/2 inches.
      - 2) Space between Wall and Rails: 2-1/4 inches.
      - 3) Either round ends of handrails or return ends of handrails smoothly to floor, wall or post.
      - 4) Handrails shall not rotate within their fittings.
    - d. Locations of Handrails:
      - 1) Provide handrails at both sides of stairs.
      - 2) Provide continuous inside handrail on switchback or dogleg stairs.
      - 3) Provide continuous handrails on both sides of the stair. When handrails are not continuous, extend handrails at least 12 inches (300 mm) beyond the top riser and at least 12 inches (300 mm) plus the width of one tread beyond the bottom riser. At the top, the extension shall be parallel with the floor or ground surface. At the bottom, continue the handrail to slope for a distance of the width of one tread from the bottom riser; the remainder of the extension shall be horizontal.
      - 4) Mount the top of handrail gripping surface between 34 and 38 inches (865 and 965 mm) above stair nosing or ramp surface.
    - e. Structural Strength of Handrails: Refer to article in this section "Performance Requirements".
  2. Notify Architect of details or specifications not conforming to code.

## 1.6 COORDINATION

- A. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

### 2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

### 2.3 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513, Type 5 (mandrel drawn).
- C. Iron Castings: Either gray or malleable iron, unless otherwise indicated.
  - 1. Gray Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.
  - 2. Malleable Iron: ASTM A 47/A 47M.
- D. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.
- E. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

- F. Perforated Metal Panel: 16 gage thick plain steel perforated panel with 3/16 inch diameter holes with 32 percent open area. Provide by McNichols or approved substitute.

## 2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars and Tubing: ASTM B 221, Alloy 6063-T5/T52.
- C. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.
- D. Plate and Sheet: ASTM B 209, Alloy 6061-T6.

## 2.5 FASTENERS

- A. General: Provide the following:
  - 1. Ungalvanized-Steel Stairs and Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
  - 2. Aluminum Railings: Type 304 stainless-steel fasteners.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36.
- D. Machine Screws: ASME B18.6.3.
- E. Lag Bolts: ASME B18.2.1.
- F. Plain Washers: Round, ASME B18.22.1.
- G. Lock Washers: Helical, spring type, ASME B18.21.1.
- H. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

## 2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
  - 1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
1. Available Products:
    - a. Five Star Grout by Five Star Products, Inc.
    - b. Masterflow 928 Grout by Master Builders Technologies.
    - c. SonogROUT 10K by Sonneborn.
    - d. 14K Hy Flow by Sonneborn.
- E. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
- F. Welded Wire Fabric: ASTM A 185, 6 by 6 inches--W1.4 by W1.4, unless otherwise indicated.

## 2.7 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
1. Join components by welding, unless otherwise indicated.
  2. Use connections that maintain structural value of joined pieces.
  3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Weld exposed corners and seams continuously, unless otherwise indicated.
  5. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

- G. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- I. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

## 2.8 STEEL-FRAMED STAIRS

### A. Stair Framing:

- 1. Fabricate stringers of steel channels, C12x20.7 minimum.
  - a. Provide closures for exposed ends of channel stringers.
- 2. Construct platforms of steel channel headers and miscellaneous framing members as indicated.
- 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
- 4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
- 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

### B. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.0677 inch.

- 1. Steel Sheet: Uncoated cold-rolled steel sheet.
- 2. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
- 3. Shape metal pans to include nosing integral with riser.
- 4. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

## 2.9 TUBE RAILINGS

### A. General: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

- 1. Configuration: As indicated on the drawings.

### B. Welded Connections: Fabricate railings with 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.

### C. Form changes in direction of railings as follows:

- 1. As detailed.



- D. Form simple and compound curves by bending members in 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.
- E. Close exposed ends of railing members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
  - 1. Connect posts to stair framing by direct welding, unless otherwise indicated.
  - 2. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
- H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

#### 2.10 FOLDING STAIRWAY

- A. Metal Folding Disappearing Stairway including stairway, frame and door. Provide model SS/AL-90.
- B. Manufacturer: Precision Ladders, LLC, P. O. Box 2279 - Morristown, Tennessee 37816-2279. Phone: (800) 225-7814. FAX: (423) 586-2091.

#### 2.11 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

#### 2.12 STEEL AND IRON FINISHES

- A. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:

1. Interior Railings: SSPC-SP 3, "Power Tool Cleaning."
- C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 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. Shop prime uncoated railings with universal shop primer unless indicated.

## 2.13 ALUMINUM FINISHES

- A. Mechanical Finish: AA-M12 (Mechanical Finish: nonspecular as fabricated).
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete, unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Field Welding: Comply with the following requirements:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- G. Place and finish concrete fill for treads and platforms to comply with Division 03 Section "Cast-in-Place Concrete."

### 3.2 INSTALLING TUBE RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
1. Anchor posts to steel by welding directly to steel supporting members.
  2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.
- B. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as follows:
1. Use type of bracket with predrilled hole for exposed bolt anchorage.
  2. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  3. For hollow masonry anchorage, use toggle bolts.
  4. For steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
  5. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.

### 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 for touching up shop-painted surfaces.
1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.

END OF SECTION 055100

## SECTION 061000 - ROUGH CARPENTRY

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Rooftop equipment bases and support curbs.
  - 2. Wood blocking and nailers.
  - 3. Plywood backing panels.
- B. Related Sections include the following:
  - 1. Division 06 Section "Sheathing."

## 1.3 DEFINITIONS

- A. Exposed Framing: Framing not concealed by other construction.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- C. Timber: Lumber of 5 inches nominal or greater in least dimension.
- D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
  - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
  - 2. NLGA: National Lumber Grades Authority.
  - 3. RIS: Redwood Inspection Service.
  - 4. SPIB: The Southern Pine Inspection Bureau.
  - 5. WCLIB: West Coast Lumber Inspection Bureau.
  - 6. WWPA: Western Wood Products Association.

## 1.4 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for wood-preserved treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
  - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.
2. Product Data for Credit EQ 4.4: For composite-wood products, documentation indicating that product contains no urea formaldehyde.
3. Credit MR 5.1: Product Data indicating location of material manufacturer for regionally manufactured materials.
  - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.
  - b. Include statement indicating cost and distance from point of extraction, harvest, or recovery to Project for each raw material used in regionally manufactured materials.

C. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

D. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Wood-preserved-treated wood.

## 1.5 QUALITY ASSURANCE

A. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

### 2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

## 2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA C2.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
  - 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. 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, 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 floor plates that are installed over concrete slabs-on-grade.

## 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in AWPA C27 (plywood).
  - 1. Use Interior Type A, unless otherwise indicated.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
- C. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- D. Application: Treat items indicated on Drawings.

## 2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Rooftop equipment bases and support curbs.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 15 percent maximum moisture content of any species.
- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

## 2.5 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

## 2.6 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, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
  - 2. Where rough carpentry is pressure-preservative treated and exposed to the weather, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Cold-Formed Metal Framing: Hilti Kwik-Flex or Elco Drill-Flex; no substitutes,
  - 1. Plywood sheathing: 10-24 x 1-1/4 inch wafer head #3.
  - 2. 2 x wood blocking: 12-24 x 2-1/2 inch wafer head #3.
- F. Lag Bolts: ASME B18.2.1.
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
  - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

## PART 3 - EXECUTION

### 3.1 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

### 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 wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000



## SECTION 061600 - SHEATHING

## 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. Wall sheathing.
  - 2. Miscellaneous sheathing.
- B. Related Sections include the following:
  - 1. Division 06 Section "Rough Carpentry" for plywood backing panels.

## 1.3 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

## 1.4 QUALITY ASSURANCE

- 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."

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

## 2.1 WOOD PANEL PRODUCTS, GENERAL

- A. Plywood: DOC PS 1.
- B. Oriented Strand Board: DOC PS 2.

- C. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- D. Factory mark panels to indicate compliance with applicable standard.

## 2.2 WALL SHEATHING

- A. Plywood Wall Sheathing: Exposure 1, Structural I (CDX) sheathing.
  - 1. Span Rating: Not less than 24/0 or 32/16.
  - 2. Nominal Thickness: As indicated on the drawings.

## 2.3 MISCELLANEOUS SHEATHING

- A. Plywood Sheathing: Exposure 1, Structural I (CDX) sheathing.
  - 1. Span Rating: Not less than 24/0 or 32/16.
  - 2. Nominal Thickness: As indicated on the drawings.

## 2.4 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.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
  - 1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

## 2.5 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
  - 1. Use adhesives that 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 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- 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."
- D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and miscellaneous sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

## 3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30S, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
  - 1. Wall and Miscellaneous Sheathing:
    - a. Nail to wood framing.
    - b. Screw to cold-formed metal framing.
    - c. Space panels 1/8 inch apart at edges and ends.

END OF SECTION 061600

## SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:

1. Interior standing and running trim.
2. Wood cabinets, bookshelves and cases.
3. Storage cabinets and cubbies.
4. Plastic-laminate countertops.
5. Solid-surfacing-material countertops.
6. Composite countertops.
7. Linoleum countertops.
8. Display case components.
9. Open wall shelving.
10. Shop finishing of interior woodwork.
11. Light shelf components.

- B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
2. Division 08 Section "Hollow Metal Doors and Frames" for display cabinet frames not specified in this Section.
3. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for interior storefront to receive Agfiber panels as indicated on the drawings.
4. Division 22 Section "Plumbing Fixtures" for faucets and pipe wraps not specified in this section.

## 1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

## 1.4 SUBMITTALS

- A. Product Data: For panel products solid-surfacing material cabinet hardware and accessories and finishing materials and processes.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, and other items installed in architectural woodwork.

C. Samples for Verification:

1. Lumber and panel products with shop-applied opaque finish, 50 sq. in. for lumber and 8 by 10 inches for panels, for each finish system and color, with 1/2 of exposed surface finished.
2. Shop-applied transparent finishes on substrate with edging.

D. Keying Schedule: Prepare Owner's final keying instructions for locks. Include schematic keying diagram.

E. LEED Submittals:

1. Product Data for Credit EQ 4.1: For installation adhesives, including printed statement of VOC content.
2. Product Data for Credit EQ 4.4:
  - a. For each composite-wood product used, documentation indicating that the bonding agent contains no urea formaldehyde.
  - b. For each adhesive used, documentation indicating that the adhesive contains no urea formaldehyde.
3. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content
  - a. Include statement indicating costs for each product having recycled content.
4. Credit MR 5.1: Product Data indicating location of material manufacturer for regionally manufactured materials.
  - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.
  - b. Include statement indicating cost and distance from point of extraction, harvest, or recovery to Project for each raw material used in regionally manufactured materials.
5. Credit MR 6.0: Product Data for rapidly renewable materials.
  - a. Include statement indicating costs for each rapidly renewable material.

## 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with such selections and requirements in addition to the quality standard.

- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
  2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

#### 1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):
  1. Species and Grade: White maple; Clear; NHLA.
  2. Finger Jointing: Not allowed.
  3. Gluing for Width: Allowed.
  4. Face Surface: Surfaced (smooth).

5. Matching: Selected for compatible grain and color.
- C. Wood Species for Painted Finish: Eastern white pine or poplar.
- D. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
    - a. Columbia, pre-finished maple plywood.
- E. MDF Products: Comply with the following:
1. Recycled Content of Medium-Density Fiberboard: Provide products with an average recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 85 percent.
  2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
- F. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
1. Colors: Provide full color options available from Panolam or Panval not just standard white, putty, almond, and grey.
- G. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
    - a. Panolam Industries International Incorporated. (Pionite)
- H. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Bradley; Terreon RE® Lav Deck.
    - b. E. I. du Pont de Nemours and Company. (Corian)
- I. Ag-Fiber Panels: Decorative panel consisting of agricultural fiber formed into 3 by 6 foot sheets under heat and pressure.
1. Products: Kirei board, 20 mm.
- J. Homasote: Provide 1/2 inch thick N.C.F.R. Homasote with Class A fire rating.
- K. Tempered Float Glass for Cabinet Doors: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, with exposed edges seamed before tempering, 6 mm thick, unless otherwise indicated.
- L. Tempered Float Glass for Cabinet Shelves: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3; with exposed edges seamed before tempering, 6 mm thick.

## 2.2 CABINET AND DISPLAY CASE HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
- B. Butt Hinges: 2-3/4-inch, 5-knuckle steel hinges made from 0.095-inch-thick metal, and as follows:
1. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.
  2. Available Products: RCP Casework Hardware, No. 374 and 376, five-knuckle hinge for overlay doors.
- C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
- D. Adjustable Shelf Standards and Supports for Cabinets: No substitutions.
1. Available Products:
    - a. Knappe & Vogt Mfg. Co.: No. 87 heavy-duty brackets, No. 187 standards, anachrome finish.
    - b. Knappe & Vogt Mfg. Co.: No 255 Pilaster and support, zinc finish.
- E. Drawer and Door Locks: Provide Locks by Olympus Lock, Inc.; 100 DR door lock and 200 DW drawer lock. No substitutions.
1. Provide 6 master keys with all locks keyed alike.
  2. Provide on all drawers and doors as indicated on drawings.
  3. Provide epoxy adhesive to retain lock attachments in place.
- F. Drawer Slides: BHMA A156.9, B05091; Heavy Duty (Grade 1HD-100): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
1. Available Products:
    - a. Accuride 9301.
    - b. KV 8417.
- G. Catches: Magnetic catches, BHMA A156.9, B03141.
- H. Aluminum Slides for Sliding Glass Doors: Rollers and track system for sliding glass doors, Hafele EKU-Clipo 15/GS System. Complete assembly consisting of running gear with mounting part, stopper, guide, frame mounting angle, and running rail support clip. Also provide rails, covering profile, glass gasket, hardware, and glass fixing profiles.
- I. Sliding Door Locks: Knappe & Vogt #963 CHR, or approved substitute, ratchet lock for 1/4" glass, laps 3/4" to 3-3/8". May be keyed alike or with up to twelve key changes. Polished chrome finish.
- J. Counter Support Brackets: Provide one of the following
1. 1/8 inch thick steel bracket with powder coat finish. Provide Work Station Brackets by A & M Hardware, Inc. (888-647-0200) or approved substitute.
  2. Model SWS4 by Doug Mockett, Manhattan Beach, California.
  3. Short Run Pro countertop bracket.
- K. Grommets for Cable Passage through Countertops: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.



1. Product: Provide "SG series" by Doug Mockett & Company, Inc.
  2. Color: As selected by Architect from manufacturer's full range.
- L. Wire Rope Shelf Support System: Provide wire rope and support components by Grip Lock Systems or approved substitute.
1. Wire Rope: AS-16; 1/16 inch diameter, 7x7 stainless steel aircraft cable.
  2. Floor Mounts: DG-25-APLT-SAT; gripper with anchor plate, satin chrome finish.
  3. Ceiling Mounts: DG-25-APLT-SAT; glider with anchor plate, satin chrome finish.
  4. Midway Components: DG-25-SCU-SAT; universal side-clamp, satin chrome finish.
  5. Provide for weight loads as indicated on drawings.
- M. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
  2. Satin Stainless Steel: BHMA 630.
- N. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

### 2.3 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives 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. Contact Adhesive: 250 g/L.

### 2.4 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
1. Corners of Cabinets and Edges of Members and Rails: 1/16 inch.

- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
  - 1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

## 2.5 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Grade: Premium.
- B. Wood Species and Cut: White maple, clear.
- C. For items wider than available lumber, use veneered construction. Do not glue for width.
- D. For rails wider or thicker than available lumber, use veneered construction. Do not glue for width or thickness.
- E. 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.
- F. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.

## 2.6 WOOD CABINETS AND CASES FOR TRANSPARENT FINISH

- A. Grade: Premium, unless noted otherwise.
- B. AWI Type of Cabinet Construction: Reveal overlay with face frame.
- C. Component Materials:
  - 1. Body Members: Ends, bottom, divisions, rails and tops: 3/4 inch pre-finished maple plywood panels and matching vinyl edge band, with clear finish, all exposed and semi-exposed sides. Provide Type B or C flush joint for underside of wall cabinets as required by AWI 400-G-7.
  - 2. Shelves: 3/4 inch thick panels. Provide 1 inch thick where shelf widths are required to meet AWI 400-G-8.
  - 3. Backs: 3/8 inch thick pre-finished maple plywood panels.
  - 4. Drawer sides, backs: 1/2" panels or solid lumber.
  - 5. Drawer Bottoms: 1/4" pre-finished maple plywood panels.
  - 6. Drawer Fronts: 20 mm Kirei Board panels with 1/8" maple edge band at all sides. Run grain horizontally.
  - 7. Cabinet Doors: 20 mm Kirei Board panels with 1/8" maple edge band at all sides. Run grain vertically.
  - 8. Edging: 1/8 inch thick maple wood edge at all exposed and semi-exposed edges.
  - 9. Base Toe Kick: 3/4" plywood.

**2.7 PLASTIC-LAMINATE COUNTERTOPS**

- A. Grade: Premium.
- B. High-Pressure Decorative Laminate Grade: HGS.
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  - 1. Plam 1: Pionite PFA63 Suede – Searching for Atlantis.
  - 2. Plam 2: Pionite AT241 Suede – Cinnamon Fiber.
  - 3. Plam 3: Pionite PFA45 – Alive in Memphis.
  - 4. Plam 4: Pionite MB060 – Vermont Granite.
  - 5. Plam 5: Pionite AT991 – Suede Wheat Fiber.
- D. Edge Treatment: Clear shop-finished, solid maple edge, size and profile as indicated on the drawings.
- E. Core Material: MDF.
- F. Core Material at Sinks: MDF.

**2.8 SOLID-SURFACING-MATERIAL COUNTERTOPS**

- A. The multiple integral solid surface counter top and bowl shall be Bradley Terreon RE® Lav Deck Model as indicated on drawings, with 3 inch front and side aprons. The integral top and bowl shall provide hand washing stations as indicated on drawings. Each hand washing station mounted at standard height shall comply with ANSI and ADA accessibility standards.
- B. Deck and bowl material for each station shall be constructed of NAHB certified Terreon RE®, complying with ANSI Z124.3, Z124.6 and ANSI/ICPA SS-1-2001.
  - 1. Color for Countertop: To be determined.
  - 2. Color for Sink bowl: To be determined.
- C. Deck to have a round cutout of 6-1/2 inch diameter within countertop for trash pass through as indicated on drawings. Cutouts to be round with all edges smooth and edged.
  - 1. Locations for Cutouts: Toilet 105, 106, 133 and 134.
- D. Unit to be supported by Stainless Steel Mounting Brackets with a Terreon® strip.
- E. At Café 103 only, each bowl's plumbing shall be concealed by a model LD-TRAP Single Station Stainless Steel Trap Cover.

**2.9 COMPOSITE COUNTERTOPS**

- A. Tops, General: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Make exposed edges and corners uniformly beveled. Provide front and end overhang of 1 inch (25 mm) over base cabinets.
- B. High-Pressure Laminate Tops: Flat panels, factory molded with thermosetting resins, reinforced with cellulose fibers, to provide a uniform mixture throughout full thickness with smooth, nonspecular finish.

1. Product: Provide Athlon by Trespa.
2. Color: To be determined.
3. Fabricate tops with loose backsplashes for field applications.
  - a. Top Thickness: 1/2 inch.

C. Installation Materials: Provide countertop manufacturer's recommended joint adhesive, panel adhesive and sealants as required to suit project conditions.

## 2.10 LINOLEUM COUNTERTOPS

A. Countertops constructed with MDF, as indicated, with linoleum sheet flooring adhered to form counter surface. Provide wood edging as indicated on the drawings.

B. Linoleum Sheet (LFS): Where this designation is indicated, provide linoleum floor covering with backing complying with the following:

1. Available Products: As follows:
  - a. Marmoleum by Forbo: As indicated from Vivace Collections.
2. Composition: Linseed oil, wood flour, rosin binders and dry pigments.
3. Static Coefficient of Friction: Ramp Surfaces: Minimum 0.6.
4. Overall Thickness: 0.10 inch (2.5 mm).
5. Wearing Surface: Smooth.
6. Backing: Jute.
7. Sheet Width: 6.5 feet.
8. Seaming Method: Chemically bonded.

C. Color and Pattern: As follows:

1. LFS-13: Vivace 3409 Fairy Blue.
2. LFS-14: Vivace, 3403 Asian Tiger.
3. LFS-15: Vivace, 3406 Aquarius.
4. LFS-16: Vivace, 3415 Purple Passion.
5. LFS-17: Vivace, 3407 Donkey Island.

D. Comply with manufacturer's written instructions for installing floor coverings.

E. Edge Treatment: Solid maple wood edge, shop finished, size and profile as indicated.

F. Core Material: MDF.

G. Core Material at Sinks: MDF.

## 2.11 OPEN WALL SHELVING

A. Melamine Shelving:

1. 20 inch wide melamine panels, 3/4 inch thick unless noted otherwise.
2. Wall Brackets: Knape & Vogt No. 187, slotted standards with No. 87 heavy-duty U-Brackets with anachrome finish.

## 2.12 LIGHT SHELF COMPONENTS

- A. Panels: 20 mm Kirei Board panels with plastic laminate applied to top surface and clear finished bottom surface.
  - 1. Plam 6: Pionite SW826 Gloss Angel White.
- B. Frame: Provide 3/4 by 3/4 inch aluminum angle frame with mitered corners and fastened to Kirei panels.
- C. Wire Supports: Provide 1/16 inch diameter, 7x7 stainless steel aircraft cable with associated clamps and turnbuckles for adjusting.

## 2.13 SHOP FINISHING

- A. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork, specified in this section, at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.
- D. Transparent Finish: ML Campbell Wood Finishing System; Magnamax Hi-Solid Water White precatalyzed clear lacquer.
- E. Apply clear finish to all edge of AgFiber panels to the extent possible, ensuring compatibility with all adhesives.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

### 3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches long, except where shorter single-length pieces are necessary.
  - 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
  - 2. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.
- G. Cabinets and Cases: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.

### 3.3 INSTALLATION OF PLASTIC LAMINATE TOPS

- A. Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
  - 1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 2. Secure backsplashes to walls with adhesive.
  - 3. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

### 3.4 INSTALLATION OF COMPOSITE TOPS

- A. Top Installation: Install tops plumb and level, and scribe to adjacent surfaces in accordance with manufacturer's recommendations.
- B. Fasten laboratory tops to supporting casework with fasteners and adhesive appropriate for use with adjoining construction as indicated on drawings and as recommended by manufacturer.
- C. Form field joints using manufacturer's recommended adhesive. Form inconspicuous and nonporous joints. Seal flexible joints using manufacturer's recommended adhesive.

3.5 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

## SECTION 066400 - PLASTIC PANELING

## 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 extruded PVC wall paneling and trim accessories.
- B. Related Sections:
  - 1. Division 06 Section "Rough Carpentry" for wood furring for installing plastic paneling.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
  - 1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content and chemical components.
- C. Samples for Selection: For plastic paneling and trim accessories.

## 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
  - 3. Testing Agency: UL.

## 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.



## PART 2 - PRODUCTS

## 2.1 PLASTIC SHEET PANELING

- A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Altro Whiterock Extruded.
  - 2. Nominal Thickness: Not less than 0.80 inch.
  - 3. Surface Finish: Manufacturer's standard.
  - 4. Color: White.

## 2.2 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard two-piece, snap-on vinyl extrusions designed to cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
  - 1. Color: Match panels.
- B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
- C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.
- D. Adhesive: As recommended by plastic paneling manufacturer.
  - 1. VOC Content: 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Sealant: Single-component, mildew-resistant, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Division 07 Section "Joint Sealants."
  - 1. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Remove loose or soluble paint, and other materials that might interfere with adhesive bond.

- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.
  - 1. Mark plumb lines on substrate at trim accessory locations for accurate installation.
  - 2. Locate trim accessories and panel joints to allow clearance at panel edges according to manufacturer's written instructions.

### 3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Follow adhesive manufacturer's recommendations for appropriate height of adhesive bead left by trowel. Use a "crosshatch" type pattern. Make sure adhesive extends to all edges of the panel. Adhesive should be applied directly to the back of the panel.
- C. Start in corner. Install one piece corner molding. Apply silicone sealant in molding. Slide panel into molding and withdraw 1/8" (3.2mm). This will provide the appropriate gap as recommended. Begin in corner nearest molding and with laminate roller begin rolling out towards the edge without the molding.
- D. Continue rolling down and out working your way across the panel away from the previously installed panel or initial molding to remove all trapped air.
- E. Install fasteners as each panel is being put in place and before next molding is put on. This will help work out any air pockets and help ensure a flat installation. Install fasteners 16" (406.4mm) on center both directions. Space perimeter holes at least 1" to 1-1/2" (25.4mm - 38.1mm) from the panel edge when using 1-piece moldings and stagger holes of abutting panels. When using 2 piece moldings put perimeter holes 1-1/2" to 2" (38.1mm - 50.8mm) away from the panel edge if possible. Remember to overdrill holes 1/8" larger than fastener.
- F. Plan ahead so fasteners will not interfere with moldings or other wall fixtures. Do not fasten perimeter of panels until panel has been rolled out. Drill hole into substrate through predrilled holes in panel. Try to center fasteners as much as possible within predrilled hole.
- G. Start fastening at edge with installed molding and work toward the other side. Continue installing fasteners one row at a time until fastening is complete. Apply silicone sealant beneath rivet or fastener. Install other molding after fastening is complete.
- H. Install one piece division bar and caps or next molding by laying down bead of silicone sealant in molding and sliding onto the panel. Withdraw the molding 1/8" (3.2mm), again to provide proper spacing. The free edge of the molding may be tacked in place if preferred before installing the next panel.
- I. Repeat the process working in one direction across the ceiling.
- J. Apply silicone sealant in all moldings and around all panel edges, fasteners, and fixtures to provide a moisture proof installation.

- K. 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.

END OF SECTION 066400

## SECTION 071113 - BITUMINOUS DAMPPROOFING

## 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. Cold-applied, emulsified-asphalt dampproofing.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.
- B. Material Certificates: For each product, signed by manufacturers.
- C. LEED Submittal:
  - 1. Product Data for Credit EQ 4.2: For dampproofing, including printed statement of VOC content.

## 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

## 1.5 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

## PART 2 - PRODUCTS

## 2.1 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Degussa Building Systems; Sonneborn Brand Products.
  2. Karnak Corporation.
  3. Meadows, W. R., Inc.
- B. Trowel Coats: ASTM D 1227, Type II, Class 1 or Type IV.
1. Available Products:
    - a. Sealmastic, Type 3; W. R. Meadows
    - b. Hydrocide 700; Sonneborn Building Products.
    - c. Karnak 920 AF; Karnac Chemical Corp.
- C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1 or Type IV.
1. Available Products:
    - a. Sealmastic, Type 2; W. R. Meadows
    - b. Hydrocide 700B; Sonneborn Building Products.
    - c. Karnak 220 AF; Karnac Chemical Corp.
- D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
1. Available Products:
    - a. Sealmastic, Type 1; W. R. Meadows
    - b. Hydrocide 600; Sonneborn Building Products.
    - c. Karnak 100 AF; Karnac Chemical Corp.
- E. VOC Content: 0.25 lb/gal. or less.

## 2.2 MISCELLANEOUS MATERIALS

- A. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.
- B. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- C. Patching Compound: Epoxy or latex-modified repair mortar or manufacturer's fibered mastic of type recommended by dampproofing manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
  1. Proceed with dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.
  2. Test for surface moisture according to ASTM D 4263.

### 3.2 PREPARATION

- A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.
- C. Apply patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

### 3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.
  - 1. Apply additional coats if recommended by manufacturer or if required to achieve coverages indicated.
  - 2. Allow each coat of dampproofing to cure 24 hours before applying subsequent coats.
  - 3. Allow 24 hours drying time prior to backfilling.
- B. Apply dampproofing to footings and foundation walls where opposite side of wall faces building interior (interior concrete retaining walls and elevator pit).
  - 1. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches over outside face of footing.
  - 2. Extend 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
  - 3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

### 3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. On Concrete Foundations: Apply 2 brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat, 1 fibered brush or spray coat at not less than 3 gal./100 sq. ft., or 1 trowel coat at not less than 4 gal./100 sq. ft..
- B. On Unexposed Face of Concrete Retaining Walls: Apply 1 brush or spray coat at not less than 1.25 gal./100 sq. ft..

### 3.5 CLEANING

- A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION 071113

## SECTION 072100 - THERMAL 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. This Section includes the following:
  - 1. Perimeter insulation under slabs-on-grade.
  - 2. Perimeter wall insulation (supporting backfill).
  - 3. Concealed building insulation.
- B. Related Sections include the following:
  - 1. Division 04 Section "Unit Masonry" for insulation installed in cavity walls and masonry cells.
  - 2. Division 07 Section "Thermoplastic Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.
  - 3. Division 09 Section "Gypsum Board" and "Gypsum Board Shaft-Wall Assemblies" for installation in metal-framed assemblies of insulation specified by referencing this Section.
  - 4. Division 21 Section "Fire-Suppression Systems Insulation."
  - 5. Division 22 Section "Plumbing Insulation."
  - 6. Division 23 Section "HVAC Insulation."

## 1.3 DEFINITIONS

- A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units for each type of exposed insulation indicated.
- C. LEED Submittal:
  - 1. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

- E. Research/Evaluation Reports: For foam-plastic insulation.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
  - 1. Surface-Burning Characteristics: ASTM E 84.
  - 2. Fire-Resistance Ratings: ASTM E 119.
  - 3. Combustion Characteristics: ASTM E 136.
- C. Recycled Content: Provide extruded polystyrene insulation with recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 30 percent.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
  - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
  - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

### 2.2 FOAM-PLASTIC BOARD INSULATION

- A. Recycled Content: Provide extruded polystyrene insulation with recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 30 percent.



- B. Rigid Insulation: Extruded-Polystyrene Board Insulation; ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:
1. Available Products:
    - a. Foamular 250; Owens Corning.
    - b. Styrofoam by Dow Chemical Co. (available from Conn. Plant)
    - c. Amfoam-CM by Tenneco Building Products
  2. Type IV, 1.60 lb/cu. ft., unless otherwise indicated.
  3. R-Value: 5 per inch.
  4. Application:
    - a. Perimeter foundation insulation.
    - b. Rigid insulation below concrete slab-on-grade.
    - c. Rigid insulation at exterior walls with metal siding.

### 2.3 SPRAYED FOAM INSULATION

- A. Sprayed Polyurethane Foam Sealant for Perimeter of Doors and Windows: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft. density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
1. Products:
    - a. Great Stuff Window & Door by Dow
    - b. Froth-Pak by Insta-Foam Products, Inc.
    - c. Pur-Fill 1G by Todol Products, Inc.
    - d. Handi-Seal Window and Door Sealant by Fomo Products, Inc.

### 2.4 AUXILIARY INSULATING MATERIALS

- A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.
- B. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, and depth required to fit insulation thickness indicated.
1. Nominal Thickness: 18 gage.
- C. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

### 3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

### 3.4 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

- A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
  1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
- C. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.
- D. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

### 3.5 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

- C. Apply foamed-in-place insulation, by spray or froth method to a uniform monolithic density without voids into miscellaneous voids and cavity spaces where shown.

### 3.6 EXTERIOR WALL INSULATION INSTALLATION

- A. Board Insulation: Extend insulation in thickness indicated to cover entire wall.
  - 1. Erect insulation horizontally and hold in place with Z-shaped furring members spaced 24 inches o.c. Attach furring members to substrate with screws spaced 24 inches o.c.

### 3.7 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

## SECTION 072616 - BELOW-GRADE VAPOR RETARDERS

## 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. Vapor retarders under slabs-on-grade.

## 1.3 DEFINITIONS

- A. Vapor Retarder: Material with a water vapor transmission rating of not over 0.04g per square foot per hour.
- B. Vapor Barrier: Material with a water vapor transmission rating of not over 0.015g per square foot per hour.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification:
  - 1. Vapor Retarder: 12 inch (300 mm) square unit.
  - 2. Vapor Retarder Tape: 12 inch long sample.
  - 3. Double-Stick Edge Tape: 12 inch long sample.

## 1.5 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. At least 7 days prior to starting installation of below-grade vapor retarder, conduct a meeting to review detailed requirements for materials and to determine procedures for a satisfactory installation of vapor retarder system.
  - 2. Review methods and procedures related to vapor retarder installation, including manufacturer's written instructions.
  - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review edge tape installation, special penetration details, and condition of other construction that will affect vapor retarder system.
  - 5. Review repair procedures after vapor retarder installation.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

## 1.7 PROJECT CONDITIONS

- A. Separate and recycle waste materials.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Available Manufacturers and Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following products listed in Part 2 of this Section.

## 2.2 VAPOR RETARDERS FOR UNDER SLABS

- A. Vapor Retarder with extremely low permeance for critically sensitive, low permeance floor coverings such as rubber, vinyl, urethane, epoxy and methyl methacrylate, as well as linoleum and wood, having the following qualities:
  - 1. Minimum Permeance: ASTM E-96, not greater than 0.01 perms.
  - 2. Tensile Strength: ASTM E154 or D638, Class A – over 45 lbf/in.
  - 3. Puncture Resistance: ASTM E-154, Class B – over 1700 grams.
  - 4. Water Vapor Barrier: ASTM E-1745, meets or exceeds Class B.
  - 5. Thickness of Barrier (Plastic) ACI 302.1R-96, not less than 15 mils.
- B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Stego Wrap, 15 mil thick vapor retarder by Stego Industries LLC, (877) 464-7834.
  - 2. Vaporguard by Reef Industries.
  - 3. Sealtight Perminator 15 mil Underslab Vapor-Mat by W.R. Meadows, Inc.
  - 4. Viper VaporCheck 16 by Insulation Solutions, Inc.
- C. Vapor-Retarder Tape (for slabs): Stego Warp red polyethylene tape or tape as recommended by the manufacturer.
- D. Double-Stick Edge Tape: Preformed 1-1/2" wide two-sided adhesive. Available products include "Fab Tape" by Reef Industries.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrates of substances harmful to vapor retarders, including removing projections capable of puncturing vapor retarders, or of interfering with attachment.
- B. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

### 3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions applicable to products and application indicated.
- B. Extend retarders in thickness indicated to envelop entire area to be covered. Cut and fit tightly around obstructions. Remove projections that interfere with placement.

### 3.4 INSTALLATION OF UNDER-SLAB VAPOR RETARDERS

- A. Moisture vapor retarder system shall be installed at all interior floor slabs and as otherwise indicated in the drawings in strict accordance with the manufacturer's printed instructions and as follows:
  - 1. Snap chalk line along inside perimeter of foundation walls at top of slab elevation.
  - 2. Without wetting, clean a 3" wide band on the surface of the concrete below the chalk line at approximately mid-slab height. Remove dirt, residual form release, or other bond inhibiting surface contaminants. Grind smooth any surface projections within the band.
  - 3. While removing the contact paper on the backside, firmly press 2" wide double-stick edge tape onto wall, parallel to the chalk line on the cleaned band at mid-slab elevation.
  - 4. Remove contact paper on the face side.
  - 5. Apply a 12" wide strip of vapor retarder covering only the bottom 1" of contact surface on the edge tape. Cut, fit, and seal corner details with vapor retarder seaming tape.
  - 6. Align top edge of Iso-Strip isolation joint material to chalk line, and press material onto remaining 1" of exposed perimeter strip adhesive.
  - 7. Roll out vapor retarder material, overlapping edge rolls and all seams by 3". Tape all seams with vapor retarder seaming tape.
  - 8. All tears, punctures, etc. to be repaired and taped as required to maintain the watertight integrity of the vapor retarder system.

### 3.5 PROTECTION

- A. Protect installed vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where vapor retarders are subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072616

## SECTION 072700 - AIR BARRIERS

## 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. Air barriers in wall assemblies.

## 1.3 DEFINITIONS

- A. Vapor Retarder: Material with a water vapor transmission rating of not over 0.04g per square foot per hour.
- B. Vapor Barrier: Material with a water vapor transmission rating of not over 0.015g per square foot per hour.
- C. Air Barrier: Material with less than .004cf/m/sf air infiltration @ 0.3 inches H<sup>2</sup>O.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Design Intent: Locate, construct, and flash air barrier membrane to perform as an air and water barrier to discharge to the outside any incidental condensation or water penetration. Air barrier membrane shall accommodate movements of building material by providing expansion and control joints as required, with appropriate air seal materials to such locations, changes in substrate and perimeter conditions.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings for Air Barrier Membrane Mockup: Submit shop drawings for mockup indicating size of mockup, detail of construction, and expansion and control joints. Include relationship with adjacent materials, sequence of installation and materials and methods for sealing penetrations. Obtain approval of shop drawings prior to construction of mockup. Revise to show changes necessary to obtain approval of mockup.
- C. Shop Drawings: Submit shop drawings indicating details of construction, including expansion and control joints. Include relationship with adjacent materials, sequence of installation and materials and methods for sealing penetrations. At a minimum, shop drawings shall include details of the following connections, as applicable to the project:
  - 1. Foundation and walls.

2. Walls and windows or doors.
3. Different wall systems.
4. Wall and roof.
5. Wall and roof over unconditioned space.
6. Walls, floor and roof across construct, control and expansion joints.
7. Wall, floor and roof to utility, pipe and duct penetrations.

D. Samples for Verification: 12 inch (300 mm) square units for each type of air barrier indicated.

E. Certifications:

1. Submit certification by air barrier manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC's)
2. Submit certificate of compatibility by air barrier manufacturer, listing all materials on the project that it connects to or that comes in contact with it.

## 1.6 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Mockups of Air Barrier Membrane Installation: Prior to installation on the building, construct mockup of typical exterior wall assembly, including connection between wall and roof, and connection between wall and glazing to indicate relationship of materials with air barrier and quality of workmanship. Use actual air barrier membrane, wall, window and roof materials. Provide several mockups if necessary to include the various conditions. Remove mockup assemblies from site at completion of project. Rebuild mockups which are not approved at no additional cost to the Owner.

1. Construct mockup in accordance with details of mockup indicated on the drawings.

C. Preinstallation Conference: Before installing air barrier system, conduct conference at Project site to comply with requirements of Division 01 Section "Project Management and Coordination." Notify participants at least 5 working days before conference.

1. Meet with Owner; Architect; air barrier installer and installers whose work interfaces with or affects air barrier.
2. Review of approved submittals.
3. Review of mockups.
4. Review methods and procedures related to air barrier installation, including manufacturer's written instructions.
5. Schedule for subsequent work covering air barrier.
6. Procedures for quality assurance.
7. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.



## 1.8 PROJECT CONDITIONS

- A. Separate and recycle waste materials.
- B. Apply air barrier within range of ambient and substrate temperatures recommended by air barrier manufacturer. Do not apply air barrier to a damp or wet substrate, unless the manufacturer specifically permits that for the product.
  - 1. Do not apply air barrier in snow, rain, fog, or mist.
  - 2. Do not apply air barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Available Manufacturers and Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following products listed in Part 2 of this Section.

## 2.2 AIR BARRIERS FOR WALL ASSEMBLIES

- A. Air Barrier for Wall Sheathing: Minimum 40 mil thick, self-adhering, polymer-modified, bituminous sheet membrane, complying with ASTM D 1970. Provide primer when recommended by underlayment manufacturer.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Carlisle Coatings & Waterproofing; CCW-705.
    - b. Grace, W. R. & Co.; Perm-A-Barrier.
    - c. Henry Company; Blueskin SA.
    - d. Meadows, W. R., Inc.; SealTight Air-Shield.
    - e. Rubber Polymer Corporation; Rub-R-Wall SA.
    - f. Tremco, Incorporated; ExoAir 110.
- B. Air Barrier for Sheathing or Concrete Masonry Units: Fluid applied rubber membrane; self-curing, synthetic rubber based material. Fluid applied membranes shall meet or exceed the performance requirements of ASTM C 836.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Carlisle Coatings & Waterproofing, Inc.: CCW-525 Liquid Cote.
    - b. Grace Construction Products: Perm-A-Barrier Liquid.
    - c. Monsey Bakor (Henry Building Envelop Systems): Airbloc 06.
    - d. Rub-R-Wall: Airtight Liquid Applied Air/Vapor Barrier System.
- C. Auxiliary Materials:
  - 1. Sheet Membrane Flashing and Transitions Strips: 40 mil thick, self-adhering membrane as recommended by the manufacturer.

2. Termination Bars: Stainless steel bar and fasteners as recommended by the manufacturer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Clean substrates of substances harmful to air barriers, including removing projections capable of puncturing air barriers, or of interfering with attachment.

#### 3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions applicable to products and application indicated.
- B. Extend air barriers in thickness indicated to envelop entire area to be covered. Cut and fit tightly around obstructions. Remove projections that interfere with placement.

#### 3.4 INSTALLATION OF AIR BARRIER

- A. Sheet Membrane: Cover wall sheathing with air barrier as indicated.
  1. Comply with manufacturer's written instructions.
  2. Cover upstanding flashing with 4-inch overlap.
  3. Seal seams, edges, and penetrations with tape.
  4. Extend into jambs of openings and seal corners with tape.
- B. Fluid-Applied Membrane: Install fluid-applied air barrier according to manufacturer's written instructions.
  1. Apply recommended primer on substrate if required.
  2. Apply in thickness not less than 0.060 in. DFT.
  3. Prepare detail areas as recommended by the manufacturer.

#### 3.5 FIELD QUALITY CONTROL

- A. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
  1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
  2. Continuous structural support of air barrier system has been provided.
  3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.

4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed.
7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Air barrier has been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

### 3.6 PROTECTION

- A. Protect installed air barriers from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where air barriers are subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072700

## SECTION 074213 - METAL WALL PANELS

## 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. Concealed-fastener, metal wall panels.

- B. Related Sections:

- 1. Division 05 Section "Cold-Formed Metal Framing" for support framing, including girts, studs, and bracing.
  - 2. Division 07 Section "Air Barriers" for continuous air barrier systems.
  - 3. Division 07 Section "Sheet Metal Flashing and Trim" for flashing and other sheet metal work that is not part of metal wall panel assemblies.

## 1.3 DEFINITION

- A. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight wall system.

## 1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

- 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of wall panel and accessory.

- B. Shop Drawings: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory-, shop- and field-assembled work.

1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
  - a. Flashing and trim.
  - b. Anchorage systems.
- C. Samples for Selection: For each type of metal wall panel indicated with factory-applied color finishes.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- E. Maintenance Data: For metal wall panels to include in maintenance manuals.
- F. Warranties: Sample of special warranties.

#### 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Source Limitations: Obtain each type of metal wall panel from single source from single manufacturer.
- C. Preinstallation Conference: Conduct conference at Project site.
  1. Meet with Owner, Architect, metal wall panel Installer, metal wall panel manufacturer's representative, and installers whose work interfaces with or affects metal wall panels, including installers of doors, windows, and louvers.
  2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  3. Review methods and procedures related to metal wall panel installation, including manufacturer's written instructions.
  4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
  5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
  6. Review temporary protection requirements for metal wall panel assembly during and after installation.
  7. Review wall panel observation and repair procedures after metal wall panel installation.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.
- B. Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal wall panel for period of metal wall panel installation.

## 1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication, and indicate measurements on Shop Drawings.

## 1.9 COORDINATION

- A. Coordinate metal wall panel assemblies with rain drainage work, flashing, trim, and construction of adjoining work to provide a leakproof, secure, and noncorrosive installation.

## 1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PANEL MATERIALS

- A. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
  - 1. Surface: Smooth, flat finish.
  - 2. Exposed Coil-Coated Finish:
    - a. 2-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to

exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

B. Panel Sealants:

1. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal wall panels and remain weathertight; and as recommended in writing by metal wall panel manufacturer.

## 2.2 MISCELLANEOUS MATERIALS

- A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

## 2.3 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. General: Provide shop-formed metal wall panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

- B. Rib-Profile, Concealed-Fastener Metal Wall Panels: Formed with raised, 1 inch wide ribs and 1/2 reveal between ribs.

1. Basis-of-Design Product: Subject to compliance with requirements, provide OPM by ATAS or approved substitute.
2. Material: Aluminum sheet, 0.032 inch thick.
  - a. Exterior Finish: 2-coat fluoropolymer.
  - b. Color: As selected by Architect from manufacturer's full range.
3. Panel Coverage: 4.5 inches.
4. Panel Height: 3/4 inch.
5. Panel Length: Provide full length panels without end joints.

## 2.4 ACCESSORIES

- A. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal wall panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to

match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

- B. Flashing and Trim: Formed from same material as wall panels. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

## 2.5 FABRICATION

- A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- C. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.
  - 1. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
  - 2. Verify that weather-resistant sheathing paper has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.



3. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 METAL WALL PANEL INSTALLATION

- A. General: Unless otherwise indicated, install sheet metal siding to comply with performance requirements, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.
  1. Shim or otherwise plumb substrates receiving metal wall panels.
  2. Flash and seal metal wall panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by metal wall panels are installed.
  3. Locate and space fastenings in uniform vertical and horizontal alignment.
  4. Install flashing and trim as metal wall panel work proceeds.
  5. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
  6. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  7. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.
- B. Fasteners: Use stainless-steel fasteners.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal wall panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.
  1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
  2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
- E. Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- F. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- G. Siding Assemblies: Fasten metal sheets to supports according to manufacturer's written instructions.

### 3.3 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  - 1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
  - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

### 3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.
- B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213

## SECTION 075423 - THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

## 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. Mechanically fastened TPO membrane roofing system.
2. Roof insulation.

## B. Related Sections:

1. Division 06 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Division 06 Section "Sheathing" for wood-based, structural-use miscellaneous plywood sheathing.
3. Division 07 Section "Sheet Metal Flashing and Trim" for metal flashings, and counterflashings.
4. Division 07 Section "Green Roofing System" for green roof system and materials.
5. Division 22 Section "Storm Drainage Piping Specialties" for roof drains.

## 1.3 DEFINITIONS

- A. TPO: Thermoplastic polyolefin.
- B. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

## 1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist wind speed of 72 mph (measured 30 feet above the ground).
- D. Energy Performance: Provide roofing system with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC-1.

### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
  - 1. Product Data for Credit SS 7.2: For roof materials, indicating that roof materials comply with Solar Reflectance Index requirement.
- C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Base flashings and membrane terminations.
  - 2. Tapered insulation, including slopes.
  - 3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
  - 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- D. Samples: Not required.
- E. Qualification Data: For qualified Installer and manufacturer.
- F. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
  - 1. Submit evidence of compliance with performance requirements.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
- H. Field quality-control reports.
- I. Maintenance Data: For roofing system to include in maintenance manuals.
- J. Warranties: Sample of special warranties.

### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed and FM Approvals approved for membrane roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- C. Source Limitations: Obtain components including roof insulation fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.
- D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
  2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
  3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
  5. Review structural loading limitations of roof deck during and after roofing.
  6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
  7. Review governing regulations and requirements for insurance and certificates if applicable.
  8. Review temporary protection requirements for roofing system during and after installation.
  9. Review roof observation and repair procedures after roofing installation.
- F. Upon completion of the installation, an inspection shall be made by the system manufacturer to ascertain that the roofing system has been installed according to the applicable manufacturer's specifications and details. No "early bird" warranty will be accepted. The results of the warranty inspection shall be submitted in writing to Owner for their review and records.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
  1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

#### 1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

#### 1.9 WARRANTY

- A. General Warranty: The warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

- B. A manufacturer's sole source 20-year written Total Roofing System Warranty shall be provided with a peak gust wind speed limitation of 72 mph (measured 30 feet above the ground). Warranty shall cover both labor and materials with no dollar limitation and shall state that the Total roofing System will remain in a watertight condition. The contractor shall provide as part of the shop drawing submittal process, certification indicating that the manufacturer has reviewed and has agreed to such wind coverage indicated.
1. Total Roofing System is defined as the following materials and provided by the roof system manufacturer: membrane, flashings, counterflashings, adhesives, sealants, insulation, overlayment, fasteners, fastener plates, fastener strips, hard rubber, metal edging, preformed fascia system. Metal termination anchor bars, roof drain flashing and sealants, and any other product utilized in this system installation.
  2. The warranty shall be for twenty (20) years starting after final acceptance of the total roofing system by the roof system manufacturer. Defective materials or installation shall be removed, properly disposed of, and replaced at the manufacturer's expense.
  3. The warranty shall provide that if within the warranty period the roofing system becomes non-watertight or if the elastomeric sheet splits, tears, or separates at the seams because of defective materials and/or materials and cost thereof shall be the responsibility of the manufacturer. Should the manufacturer or his approve applicator fail to perform repairs within 72 hours of notification, the warranty will not be voided because of work being performed by others to repair the roofing regardless of the manufacturer's warranty to the contrary.
  4. The total Roofing System shall be applied by a roofing Contractor approved by the system manufacturer. After inspection and acceptance of the installed roof system, the warranty will be issued.

## PART 2 - PRODUCTS

### 2.1 TPO MEMBRANE ROOFING

- A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlisle SynTec Incorporated.
    - b. Stevens Roofing Systems; Division of JPS Elastomerics.
  2. Thickness: 60 mils, nominal.
  3. Exposed Face Color: White.

### 2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
  2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Plastic Foam Adhesives: 50 g/L.

- b. Gypsum Board and Panel Adhesives: 50 g/L.
  - c. Multipurpose Construction Adhesives: 70 g/L.
  - d. Fiberglass Adhesives: 80 g/L.
  - e. Contact Adhesive: 80 g/L.
  - f. Other Adhesives: 250 g/L.
  - g. Single-Ply Roof Membrane Sealants: 450 g/L.
  - h. Nonmembrane Roof Sealants: 300 g/L.
  - i. Sealant Primers for Nonporous Substrates: 250 g/L.
  - j. Sealant Primers for Porous Substrates: 775 g/L.
- B. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 55 mils thick, minimum, of same color as sheet membrane.
  - C. Bonding Adhesive: Manufacturer's standard, water based.
  - D. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
  - E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
  - F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

### 2.3 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by TPO membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class I, Grade 3, felt or glass-fiber mat facer on both major surfaces.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

### 2.4 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.
- B. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch thick.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Georgia-Pacific Corporation; Dens Deck.

- C. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

## 2.5 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick, and acceptable to membrane roofing system manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
  - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
  - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
  - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
  - 4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
  - 5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
  - 6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.3 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.



- B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
  - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- G. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together.
  - 1. Fasten cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.

#### 3.4 MECHANICALLY FASTENED MEMBRANE ROOFING INSTALLATION

- A. Mechanically fasten membrane roofing over area to receive roofing and install according to roofing system manufacturer's written instructions.
  - 1. For in-splice attachment, install membranes roofing with long dimension perpendicular to steel roof deck flutes.
- B. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- C. Mechanically fasten or adhere membrane roofing securely at terminations, penetrations, and perimeter of roofing.
- D. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- E. In-Seam Attachment: Secure one edge of TPO sheet using fastening plates centered within membrane seam and mechanically fasten TPO sheet to roof deck.
- F. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
  - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
  - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
  - 3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- G. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

### 3.5 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

### 3.6 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

### 3.7 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- B. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.8 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075423

## SECTION 075563 - GREEN ROOFING SYSTEM

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Furnish all labor, materials, tools, and equipment to furnish and install a fully modular green roof system including protection fabric, modules, growth media and plant species, as shown on the Drawings.
- B. Related Work:
  - 1. Roofing Systems: Specified in Division 07 Section "Thermoplastic Polyolefin (TPO) Roofing."

## 1.3 SYSTEM DESCRIPTION

- A. Provide a fully modular (before and after installation) Green Roofing System consisting of modular sections containing vegetation area that can be delivered as a pre-assembled product to the site for installation over existing TPO Membrane Roofing System provided by others. Include all materials required by the selected green roof system manufacturer to provide a complete system and any materials required by the selected waterproofing manufacturer to maintain system warranties. Items may include some or all of the following: required root barriers/protection fabric/protection board/slip sheet, pre-planted modules, water retention or drainage mats, concrete pavers, edging, and vegetation required for a complete system.
- B. System to be of hybrid design using extensive and intensive planting areas as well as paver walkways and edging to access roof drains. Roof drains and other penetrations shall be trimmed with gravel ballast to a depth of 4"(optional, but nice aesthetic and for additional membrane protection in those exposed areas).

## 1.4 SUBMITTALS

- A. Product Data: Provide product data for all materials used in system.
- B. Shop Drawings: Provide installation plan indicating extensive and intensive planting areas, details of system components, including pavers, edging and planting layout.
- C. Submit a maintenance plan until green roof acceptance and recommendations for long term maintenance under Owner's care.

### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of selected green roof system by system manufacturer.
- B. Source Limitations: The green roof modular components, growth media and plants will be purchased from same manufacturer. A minimum of 75% by weight of the system shall be sourced from within 500 miles of the project site.
- C. Before installation of the modules, the roof shall be inspected by a technical representative of the roofing installer/manufacturer to determine the adequacy of the roof surface to accept the modules.
- D. It shall be the Owner's responsibility to determine the adequacy of the roof to support the existing and proposed loads. An Engineer's report will be provided to verify roof loading design. Verification of the integrity of the roof for water tightness (water test) shall also be the responsibility of the Owner.
- E. During or upon completion of the installation, an inspection shall be conducted by a Technical Representative of the selected green roof system to ascertain that the modules have been installed according to these specifications and details. This inspection is not intended to be a final inspection for the benefit of the owner but for the benefit of determining whether a warranty shall be issued.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of planted modules such that installation occurs within a 24-hour period from the time the modules are shipped.
- B. Maintain the health of the plants prior to installation by providing water and protection from wind, as required ensuring plant survival.
- C. Do not crack or drop modules during handling and installation.

### 1.7 PROJECT CONDITIONS

- A. Perform module installation only after appropriate roofing/membrane system has been installed and/or inspected.
- B. Restrict traffic from work areas until modules are installed. Erect signs and barriers as required.
- C. Provide hoses, etc. for temporary irrigation as needed for plant maintenance until roof system acceptance.

### 1.8 WARRANTY

- A. Provide manufacturer's standard warranty on workmanship, material components, and vegetation.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide a fully modular system by one of the following:
1. Weston Solutions. (860-368-3200)
    - a. System: GreenGrid™ Green Roof System
  2. Green Living Technologies, LLC.(800-631-8001)
    - a. System: Extensive Green Roof System
  3. Elevated Landscape Technologies, Inc. (866-306-7773)
    - a. System: ELT Easy Green™ Roofing System

## 2.2 GREEN ROOF SYSTEM COMPONENTS

- A. Modules:
1. Modules are to be black in color and are formed of min 150 mil (4-inch) and 175 mil (8-inch) HDPE (100% recycled post industrial). Each module shall provide for root protection, integrated drainage (or a drainage mat if required), integrated water storage (or water retention layer if required), and shall be pre-planted with growth media and plant species of the color and type desired by the client.
  2. Modules size: 2 feet by 2 feet and 2 feet by 4 feet or approved alternate Depths of modules are 4 inches (nominal) for extensive systems and 8 inches (nominal) for intensive systems.
  3. Module weight (weight at maximum water holding capacity):
    - a. Extensive (4-inch): 18-22 lbs per sf.
    - b. Intensive (8 inch): 36-50 lbs per sf
  4. Module clearance above the roof shall be 0.5 inches minimum to provide for free water flow beneath the system.
- B. Growth Media
1. An engineered light weight blend consisting of inorganic and organic components to be purchased from the selected green roof system manufacturer as part of a complete system meeting the recommendations of a soil scientist, weight requirements listed above, and in general accordance with FLL guidelines.
- C. Plants
1. Extensive - GreenGrid™ recommended design mix of grasses, perennials, and groundcovers that can thrive in a non-irrigated, extensive rooftop environment in the project location, or approved equal. Plants shall be selected according to their USDA hardiness zone classification and in consultation with the architect
    - a. Recommended planting density - Plants should be supplied in minimum size of 3-inches deep by 1.5-inches wide (plugs) and planted 8 inches on center.
  2. Plants shall be of appropriate size for their age, pre-planted, and well rooted prior to delivery. A minimum of 3 months pre-grow (during the growing season)\_ is required before delivery.
- D. Pavers:
1. Standard Paver Size: 2 feet by 2 feet, and 1.75-inches in depth.

2. Pavers are composed of 100% recycled rubber and are available in various colors.
  3. Standard Paver Weight: 7.5 lbs. per square foot.
- E. Edge Elements:
1. Composed of aluminum or painted steel as selected by architect for placement on viewable edge of modules.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION SEASON

- A. Unless otherwise permitted, module installation shall be done between April 1 and October 15, but not when the weather is below 50° F.

#### 3.2 SITE PREPARATION

- A. Areas to have modules installed shall have an installed roofing system, with smooth free draining and an even surface.
- B. The area shall be thoroughly cleaned of debris that might interfere with laying of the modules.
- C. Examine finish surfaces, grades, and roof quality. Do not start module installation work until unsatisfactory conditions are corrected.
- D. A geotechnical fabric or similar will be provided under the modules as a slip sheet to help protect the roofing system during module installation. This material shall meet all requirements of the waterproofing system manufacturer to maintain warranty coverage.

#### 3.3 GREEN ROOF SYSTEM INSTALLATION

- A. Install system components and accessories as recommended by the manufacturer.
- B. Install roof protection fabric/board/sheet over existing roofing membrane in areas of green roof system.
- C. Install modular trays and connect together in areas and as detailed on the drawings .
- D. Install edging and pavers as indicated on the drawings.
- E.
- F. After installing modules, all shall be watered thoroughly with a gentle spray or sprinkler to insure growth. Water shall be free of substances harmful to plant growth. Hoses or other methods of application shall be furnished by the installation Contractor.

### 3.4 MAINTENANCE

- A. Maintain modules for a period of at least 30 days after completion and acceptance of the module installation operations.
- B. Maintain modules, including watering, spot weeding, application of herbicides, fungicides, insecticides (if necessary) and replanting until a full, uniform stand of plants free of weeds, undesirable grass species, disease, and insects is achieved and accepted by the Owner.
  - 1. Water modules/plants as required to establish proper rooting as directed by green roof system manufacturer.
  - 2. Repair, rework, and replant all areas that have washed out or are eroded. Replace undesirable or dead areas with new plants.
  - 3. Apply herbicides as required to control weed growth at the nursery prior to module shipment, delivery and installation. Do not apply additional herbicides to green roof system without advanced approval of the green roof system manufacturer. Comply with all applicable local, State and Federal regulations and label instructions when applying these materials.
  - 4. Do not apply fungicides or insecticides unless absolutely required to control diseases and insects and with advanced approval of the green roof system manufacturer. Comply with all applicable local, State and Federal regulations and label instructions when applying these materials.
  - 5. Utilize nursery recommended maintenance procedures.

### 3.5 ACCEPTANCE

- A. Inspection to determine acceptance of modules will be made by the Owner, upon Contractor's request. Provide notification at least 7 working days before requested inspection date.
  - 1. Modules will be acceptable, provided all requirements, including maintenance period, have been complied with, and healthy, even colored viable plants are established. Percent coverage shall not be the basis of determining acceptance as long as minimum planting densities are met, and plants exhibit an appropriate level of maturing and size for the season and time allotted to pre-establishment before installation.
- B. Upon acceptance, the Owner will assume module/plant maintenance.

### 3.6 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair damage resulting from module installation operations.

END OF SECTION 075563

## SECTION 076200 - SHEET METAL FLASHING AND TRIM

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

## A. Section Includes:

## 1. Formed Products:

- a. Formed roof drainage sheet metal fabrications.
- b. Formed low-slope roof sheet metal fabrications.
- c. Formed wall sheet metal fabrications.

## B. Related Sections:

- 1. Division 06 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
- 2. Division 07 Section "Thermoplastic Polyolefin (TPO) Roofing" for installing sheet metal flashing and trim integral with membrane roofing.
- 3. Division 07 Section "Metal Wall Panels" for sheet metal flashing and trim integral with metal wall panels.
- 4. Division 07 Section "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
- 5. Division 07 Section "Expansion Control" for manufactured sheet metal expansion-joint covers.

## 1.3 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
  - 1. Wind Zone 2: For velocity pressures of 31 to 45 lbf/sq. ft.: 90-lbf/sq. ft. perimeter uplift force, 120-lbf/sq. ft. corner uplift force, and 45-lbf/sq. ft. outward force.
- C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 180 deg F, material surfaces.



#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
  - 1. Identification of material, thickness, weight, and finish for each item and location in Project.
  - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
  - 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  - 4. Details of termination points and assemblies, including fixed points.
  - 5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
  - 6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
  - 7. Details of special conditions.
  - 8. Details of connections to adjoining work.
- C. Samples for Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.
- D. Qualification Data: For qualified fabricator.
- E. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.
- F. Warranty: Sample of special warranty.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- C. Copper Sheet Metal Standard: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- D. Preinstallation Conference: Conduct conference at Project site.
  - 1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
  - 2. Review methods and procedures related to sheet metal flashing and trim.
  - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
  - 4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.

5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

## PART 2 - PRODUCTS

### 2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Zinc-Tin Alloy-Coated Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper, of minimum uncoated weight (thickness) indicated; coated on both sides with a zinc-tin alloy (50 percent zinc, 50 percent tin).
  1. Products: Subject to compliance with requirements, provide the following:
    - a. Revere Copper Products, Inc.; FreedomGray.

### 2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
  1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
    - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
  2. Fasteners for Zinc-Tin Alloy-Coated Copper Sheet: Copper, hardware bronze or Series 300 stainless steel.
- C. Solder:
  1. For Zinc-Tin Alloy-Coated Copper: ASTM B 32, 100 percent tin.

- D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

### 2.3 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
  - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  - 2. Obtain field measurements for accurate fit before shop fabrication.
  - 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
  - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- I. Do not use graphite pencils to mark metal surfaces.

## 2.4 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:
  - 1. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft..

## 2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof-Edge Flashing: Fabricate in minimum 96-inch- long, but not exceeding 10-foot- long, sections.
  - 1. Joint Style: Butt, with 12-inch- wide, concealed backup plate.
  - 2. Fabricate from the following materials:
    - a. Zinc-Tin Alloy-Coated Copper: 20 oz./sq. ft..

## 2.6 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12-foot- long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch- high, end dams where flashing is discontinuous. Fabricate from the following materials:
  - 1. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft..

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
  - 1. Verify compliance with requirements for installation tolerances of substrates.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  - 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
  4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
  5. Install sealant tape where indicated.
  6. Torch cutting of sheet metal flashing and trim is not permitted.
  7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Seal joints as shown and as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
  2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Pre-tinning is not required for zinc-tin alloy-coated copper.
  2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

### 3.3 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
1. Anchor scupper closure trim flange to exterior wall and solder to scupper.

### 3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at 16-inch centers.

### 3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing:
  - 1. Conform to SMACNA figure 4-3C modified. Turn up rear leg of receiver 8 inches at backup wall system. Coordinate with air barrier installation.

### 3.6 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

### 3.7 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

## SECTION 077200 - ROOF ACCESSORIES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Roof hatches.
  - 2. Roof screens.
  - 3. Roof tie-offs.
- B. Related Sections include the following:
  - 1. Division 05 Section "Metal Fabrications" for metal vertical ladders for access to roof hatches.
  - 2. Division 05 Section "Metal Stairs" for alternating tread stairs for access to roof hatches.
  - 3. Division 06 Section "Rough Carpentry" for roof sheathing, wood cants, and wood nailers.

## 1.3 DESIGN / PERFORMANCE REQUIREMENTS FOR ROOF SCREEN

- A. Design Loads: Comply with Building Code for site location and building height.
  - 1. Design to resist ASCE 7-05 - Minimum Design Loads for Buildings and Other Structures.
  - 2. Design all materials, assembly and attachments to resist snow, wind, suction and uplift loading at any point without damage or permanent set.
- B. Structural Design: Prepare structural design calculations for screen framing and attachment to structure including reactions at base supports for verification of roof structure by Architect.
- C. All welds to be performed by an AWS certified welder. Valid certification to be provided.

## 1.4 SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.
- C. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.

- D. Design Data for Roof Screen: Submit design calculations for structural components and components resisting wind loads.
- E. Samples for Roof Screen: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- F. Warranty: Special warranty specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
- B. Roof Screen Pre-Installation Meeting:
1. Convene at job site, at least seven calendar days prior to scheduled beginning of construction activities of this section, to review requirements of this section.
  2. Require attendance by representatives of the installing subcontractor (who will represent the system manufacturer), the mechanical subcontractors and other entities affected by construction activities of this section.
  3. Notify Architect four calendar days in advance of scheduled meeting date.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

#### 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.8 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

#### 1.9 WARRANTY

- A. Roof Screen: Manufacturer's warrantee is limited to five years.
1. General Extended Warranty: 20 years covering complete framing system.
  2. Panel Coating Warranty: 20 years covering film integrity, chalk resistance, and color change.



## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers listed in other Part 2 articles.

## 2.2 METAL MATERIALS

- A. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 coated and mill phosphatized for field painting.
- B. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized to comply with ASTM A 123/A 123M, unless otherwise indicated.

## 2.3 MISCELLANEOUS MATERIALS

- A. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, 1 inch thick.
- B. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.
- C. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

## 2.4 ROOF HATCHES

- A. Roof Hatches: Fabricate roof hatches with insulated double-wall lids and insulated double-wall curb frame with integral deck mounting flange and lid frame counterflashing. Fabricate with welded or mechanically fastened and sealed corner joints. Provide continuous weathertight perimeter gasketing and equip with corrosion-resistant or hot-dip galvanized hardware.

- 1. Available Manufacturers and Products:

- a. Bilco: Model "S".
- b. Dur-Red Products: Model LH.
- c. Milcor: Model M1
- d. O'Keefe's Inc.: Model RH

- 2. Loads: Fabricate roof hatches to withstand 40-lbf/sq. ft. external and 20-lbf/sq. ft. internal loads.

- 3. Type and Size: Single-leaf lid, 30 by 36 inches.

- 4. Curb and Lid Material: Galvanized steel sheet, 0.079 inch thick.

- a. Finish: Prime painted.

- 5. Insulation: Cellulosic-fiber, glass-fiber or polyisocyanurate board.

- 6. Interior Lid Liner: Manufacturer's standard metal liner of same material and finish as outer metal lid.

- 7. Exterior Curb Liner: Manufacturer's standard metal liner of same material and finish as metal curb.

8. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
  9. Fabricate units to minimum height of 12 inches, unless otherwise indicated.
  10. Hardware: Galvanized steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
    - a. Provide 2-point latch on covers larger than 84 inches.
- B. Ladder Safety Post: Manufacturer's standard ladder safety post. Post to lock in place on full extension. Provide release mechanism to return post to closed position.
1. Height: 42 inches above finished roof deck.
  2. Material and Finish: Steel tube, baked enameled.
  3. Diameter: Pipe with 1-5/8-inch OD tube.
  4. Available Products: Ladder-Up safety post by Bilco or Upright Safety Bar by Milcor.
- C. Safety Rails: Provide railing system to protect open roof hatches. System to consist of non-penetrating bases with connecting rails and gate for open side. Provide rubber roof pads for bases. Provide system meeting OSHA Standards Nos. 1910.23 and 1926.500 – 1926.503.
1. Available Products:
    - a. BlueWater Manufacturing (866-898-5237): SafetyRail 2000.
    - b. Milcor: Safety Railing MRHSR-SS 3630
    - c. Bilco: Bil-Guard Hatch Railing System

## 2.5 ROOF SCREEN

- A. Acceptable Manufacturer: RoofScreen Mfg., which is located at: 347 Coral St.; Santa Cruz, CA 95060; Toll Free Tel: 866-766-3727; Tel: 831-421-9230; Fax: 866-253-0738; Email: [request info](mailto:request_info); Web: [www.roofscreen.com](http://www.roofscreen.com)
- B. Materials:
1. Base Supports: Weldments fabricated from cold rolled steel conforming to ASTM A 1008 and fabricated with internal deck fastening points. After fabrication, apply minimum 2-4 mil baked on powder coat primer.
    - a. Height 12 inches (305 mm).
  2. Flashing Boot: Fabricated 45 mil, white, single ply TPO sheet conforming to ASTM D 6878. Provide with base flange that extends a minimum of 5 inches onto the roof surface on all four sides.
  3. Base Cap: Weldments fabricated from cold rolled steel conforming to ASTM A 1008 and fabricated to overlap base support and flashing boot a minimum of 2 inches. After fabrication finish as follows:
    - a. PVDF fluoropolymer, 1 mil, 2 coat, 70 percent.
    - b. Color: Dupont Black T6IC Polyester #PFB603S9.
  4. Base Cap Gasket: EPDM with self-adhesive closed cell foam.
  5. Framing: Carbon steel structural tubing with a 2.5 inch (64 mm) outside diameter conforming to ASTM A 500 with an Allied Tube "Gatorshield" triple layer galvanized coating. Provide with wall thickness as determined by structural calculations.

6. Connector Fittings: Fabricated from cold rolled steel conforming to ASTM A 1008. After fabrication, apply zinc plating conforming to ASTM B 633 Type 1, then baked on powder coating minimum 2-4 mil Dupont Black T6IC Polyester #PFB603S9.
7. Steel Z section: Steel sheet conforming to ASTM A 653, Class SS, with a G90 hot-dip galvanized coating.
8. Steel Hat Channel: Steel sheet conforming to ASTM A 653, Class SS, with a G90 hot-dip galvanized coating.
9. Hardware: Bolts, nuts, washers and screws 18-8 stainless steel.
10. Welding Materials: AWS D1.1; type required for materials being welded.
11. Panel:
  - a. Profile: 4 inch continuous aluminum louvers.
  - b. Base Metal:
    - 1) Minimum 24 gauge Galvalume steel sheet, AZ50, conforming to ASTM A 792 for painted and unpainted panels.
  - c. Finish:
    - 1) PVDF fluoropolymer, 1 mil, 2 coat, 70 percent.
    - 2) Color as selected by Architect from manufacturer's standard color range, 20 colors minimum.
    - 3) Coat reverse side with off-white primer coat.
  - d. Panel Fasteners: No. 14 self-tapping sheet metal screw. Color coat heads to match panel color.
  - e. Panel Trim: Same material and finish as panel. Configuration as shown on Drawings

## 2.6 ROOF TIE-OFFS

- A. Provide model number PBE75-S by American Anchor. 800-371-8221.
- B. Construction: Galvanized 3-1/2 inch diameter structural tube with 3/4 inch diameter stainless steel U-bar welded to top of steel tube.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.
  1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
  2. Verify dimensions of roof openings for roof accessories.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Install roof accessories to fit substrates and to result in watertight performance.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
- D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
- E. Roof Hatch Installation:
  - 1. Check roof hatch for proper operation. Adjust operating mechanism as required. Clean and lubricate joints and hardware.
  - 2. Attach safety railing system to roof hatch curb.
  - 3. Attach ladder safety post according to manufacturer's written instructions.
- F. Roof Screen Installation:
  - 1. Install in accordance with manufacturer's instructions.
  - 2. Install components plumb and level, accurately fitted, free from distortion or defects.
  - 3. Provide for erection loads, and for sufficient temporary bracing to maintain indicated alignment until completion of erection and installation of permanent attachments.
  - 4. Anchor fabrications to structure as indicated.
  - 5. Separate dissimilar metals and use gasketed fasteners, isolation shim, or isolation tape to eliminate possibility of corrosive or electrolytic action between metals.
  - 6. Exercise care when installing components so as not to damage finish surfaces. Touch up as required to repair damaged finishes.
  - 7. Install flashing boots at base supports as required to provide a watertight connection. Install as recommended by the manufacturer.
  - 8. Remove all protective masking from material immediately after installation.
- G. Roof Tie-off Installation:
  - 1. Weld to structural steel in accordance with manufacturer's installations.
  - 2. Coordinate installation of other roof components for waterproof installation.

### 3.3 TOUCH UP

- A. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Division 09 painting Sections.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.4 CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.

END OF SECTION 077200

## SECTION 078413 - PENETRATION FIRESTOPPING

## 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, unless specified elsewhere, through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.
- B. Related Sections include the following:
  - 1. Division 21 Sections specifying fire-suppression piping penetrations.
  - 2. Division 22 and 23 Sections specifying duct and piping penetrations.
  - 3. Division 26, 27, and 28 Sections specifying cable and conduit penetrations.

## 1.3 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:
  - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
  - 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
    - a. Penetrations located outside wall cavities.
    - b. Penetrations located outside fire-resistance-rated shaft enclosures.
  - 3. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 3.0 cfm/sq. ft at both ambient temperatures and 400 deg F.
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
  - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.

2. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittal:
1. Product Data for Credit EQ 4.1: For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.
- C. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
  2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
1. Types of penetrating items.
  2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
  3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
- E. Qualification Data: For Installer.
- F. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.
- G. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

- B. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
  - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
  - 2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:
    - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
    - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
      - 1) UL in its "Fire Resistance Directory."
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
- D. Special Inspections: Allow for 1 of each type of firestopping system to be removed and inspected for conformance with approved submittals. All firestopping shall be inspected prior to the installation of ceilings.
- E. Above Ceiling review: Prior to the installation of ceilings, a review of construction completion shall be conducted for firestopping and other items that will not be visible when the ceilings have been installed.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

#### 1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.



- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by building inspector, if required by authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, through-penetration firestop systems that may be incorporated into the Work include those systems indicated that are produced by one of the following manufacturers:
  - 1. Grace, W. R. & Co. - Conn.
  - 2. Hilti, Inc.
  - 3. Nelson Firestop Products.
  - 4. RectorSeal Corporation (The).
  - 5. Specified Technologies Inc.
  - 6. 3M; Fire Protection Products Division.
  - 7. Tremco; Sealant/Weatherproofing Division.
  - 8. USG Corporation.

### 2.2 FIRESTOPPING, GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
  - 1. Permanent forming/damming/backing materials, including the following:
    - a. Slag-/rock-wool-fiber insulation.
    - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    - c. Fire-rated form board.
    - d. Fillers for sealants.
  - 2. Temporary forming materials.
  - 3. Substrate primers.
  - 4. Collars.
  - 5. Steel sleeves.

### 2.3 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials as required by UL approved Through-Penetration Firestop System. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.
- B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- D. Elastomeric Spray: Single component, water-based elastomeric compound.
- E. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- F. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- G. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- H. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- I. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- J. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.
- K. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- L. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
  - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
  - 3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.
- M. Unfaced, Slag-Wool-/Rock-Wool-Fiber Board Insulation: ASTM C 612, maximum flame-spread and smoke-developed indices of 15 and 0, respectively; passing ASTM E 136 for combustion characteristics; and of the following density, type, thermal resistivity, and fiber color:
  - 1. Nominal density of 4 lb/cu. ft., Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F.
  - 2. Color: Natural.

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fibrex Insulations Inc.
  - b. Owens Corning.
  - c. Thermafiber.

## 2.4 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.
  1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:
  1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
  2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
  3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

### 3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
- D. Install board insulation in exterior wall construction where indicated on Drawings.

### 3.4 IDENTIFICATION

- A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:
  - 1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Through-penetration firestop system designation of applicable testing and inspecting agency.
  - 4. Date of installation.
  - 5. Through-penetration firestop system manufacturer's name.
  - 6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.
- B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

- D. Reinstall firestopping materials that have been removed for inspection.

### 3.6 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

## SECTION 079200 - JOINT SEALANTS

## 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. Silicone joint sealants.
- 2. Latex joint sealants.

- B. Related Sections:

- 1. Division 04 Section "Unit Masonry" for joint preparation for sealants.
- 2. Division 08 Section "Glazing" for glazing sealants.
- 3. Division 09 Section "Gypsum Board" for sealing perimeter joints.
- 4. Division 09 Section "Tiling" for sealing tile joints.

## 1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.

- B. LEED Submittal:

- 1. Product Data for Credit EQ 4.1: For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.

- C. Samples for Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

- D. Joint-Sealant Schedule: Include the following information:

- 1. Joint-sealant application, joint location, and designation.
- 2. Joint-sealant manufacturer and product name.
- 3. Joint-sealant formulation.
- 4. Joint-sealant color.

- E. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

- G. Warranties: Sample of special warranties.

#### 1.4 QUALITY ASSURANCE

- A. **Installer Qualifications:** An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. **Product Testing:** Test joint sealants using a qualified testing agency.
  - 1. **Testing Agency Qualifications:** An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- C. **Mockups:** Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
- D. **Preinstallation Conference:** Conduct conference at Project site.

#### 1.5 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

#### 1.6 WARRANTY

- A. **Special Installer's Warranty:** Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. **Warranty Period:** Two years from date of Substantial Completion.
- B. **Special Manufacturer's Warranty:** Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. **Warranty Period:** Five years from date of Substantial Completion.
- C. **Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:**
  - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

## 2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
  - 1. Architectural Sealants: 250 g/L.
  - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
  - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- D. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

## 2.2 SILICONE JOINT SEALANTS

- A. Sealant Type 1: Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant; ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Corning Corporation; 790 (VOC 43).
    - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
    - c. Pecora Corporation; 890 (VOC na).
    - d. Sika Corporation, Construction Products Division; SikaSil-C990.
    - e. Tremco Incorporated; Spectrem 1 (VOC 1).
- B. Sealant Type 2: Not Used.
- C. Sealant Type 3: Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant; ASTM C 920, Type S, Grade NS, Class 100/50, for Use T.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Corning Corporation; 790 (VOC 43).
    - b. Pecora Corporation; 301 NS (VOC 50).
    - c. Tremco Incorporated; Spectrem 800 (VOC 1).
- D. Sealant Type 4: Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant; ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:



- a. Dow Corning Corporation; 786(VOC 33) (Food)
- b. GE Advanced Materials - Silicones; Sanitary SCS1700.
- c. Tremco Incorporated; Tremsil 200 Sanitary (VOC 1).

E. Sealant Type 5: Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

- 1. Provide elastomeric sealant NSF certified for end-use application indicated. Provide sealant that, when cured and washed, meets requirements of Food and Drug Administration's 21 CFR, Section 177.2600 for use in areas that come in contact with food.
- 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Dow Corning Corporation; 786(VOC 33).
  - b. Kason; 3700 Series Rubbaseal Silicone Sealant.
  - c. C. R. Larence Co.; CRL 33S Silicone (VOC 39).

### 2.3 LATEX JOINT SEALANTS

A. Sealant Type 6: Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. BASF Building Systems; Sonolac (VOC 41).
  - b. Bostik, Inc.; Chem-Calk 600.
  - c. Pecora Corporation; AC-20 (VOC 31).
  - d. Tremco Incorporated; Tremflex 834.

### 2.4 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

### 2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates

and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
    - d. Exterior insulation and finish systems.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

### 3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.6 JOINT-SEALANT SCHEDULE

- A. Exterior Isolation and Contraction Joints in Cast-in-place Concrete Slabs.
  - 1. Silicone Joint Sealant: Sealant Type 3.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Exterior Control, Expansion, and Soft Joints in Masonry and Between Masonry and Adjacent Work.
  - 1. Silicone Joint Sealant: Sealant Type 1.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Exterior Control, Expansion, and Soft Joints Between Masonry and Metal Door Frames, Windows, Storefronts and Curtain Walls.
  - 1. Silicone Joint Sealant: Sealant Type 1.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Under Exterior Door Thresholds.
  - 1. Silicone Joint Sealant: Sealant Type 1.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Exterior Joints for Which No Other Sealant Type is Indicated.
  - 1. Silicone Joint Sealant: Sealant Type 1.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Interior Isolation and Contraction Joints in Cast-In-Place Concrete Slabs.
  - 1. Silicone Joint Sealant: Sealant Type 3.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Concealed Interior Perimeter Joints of Exterior Openings.
  - 1. Silicone Joint Sealant: Sealant Type 1.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- H. Exposed Interior Perimeter Joints of Exterior Openings.
  - 1. Latex Joint Sealant: Sealant Type 6.
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- I. Perimeter Joints Between Interior Wall Surfaces and Frames of Doors, Windows and Elevator Entrances.
  - 1. Latex Joint Sealant: Sealant Type 6.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- J. Vertical Joints on Exposed Surfaces of Walls and Partitions.
1. Latex Joint Sealant: Sealant Type 6.
  2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- K. Joints between Plumbing Fixtures and Walls and Floors and Between Countertops and Walls.
1. Silicone Joint Sealant: Sealant Type 4.
  2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- L. Interior Joints in Food Service Areas.
1. Silicone Joint Sealant: Sealant Type 5.
  2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- M. Interior Joints for Which No Other Sealant is Indicated.
1. Latex Joint Sealant: Sealant Type 6.
  2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

## SECTION 079513 - EXPANSION JOINT 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. Types of joints for which architectural joint systems are specified include the following:
  - 1. Exterior wall joints.
  - 2. Interior pedestrian traffic joints.
  - 3. Interior wall and ceiling joints.
  - 4. Interior soffit joints.
  - 5. Fire rated expansion assemblies
  - 6. Compression seals.
- B. Related Sections include the following:
  - 1. Division 07 Section "Thermoplastic Polyolefin (TPO) Roofing" for roof joint systems.
  - 2. Division 07 Section "Joint Sealants" for elastomeric sealants and preformed compressed-foam sealants without metal frames.

## 1.3 DEFINITIONS

- A. Architectural Joint System: Any filler or cover used to span, fill, cover, or seal a joint, except expanding foam seals and poured or foamed in-place sealants.
- B. Cyclic Movement: Periodic change between widest and narrowest joint widths in an automatically mechanically controlled system.
- C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist passage of flame and hot gases through a movement joint.
- D. Maximum Joint Width: Widest linear gap a joint system tolerates and performs its designed function without damaging its functional capabilities.
- E. Minimum Joint Width: Narrowest linear gap a joint system tolerates and performs its designed function without damaging its functional capabilities.
- F. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage of nominal value of joint width.
- G. Nominal Joint Width: Width of linear gap indicated as representing the conditions existing when architectural joint systems will be installed or, if no nominal joint width is indicated, a width equal to the sum of maximum and minimum joint widths divided by two.

## 1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide factory-fabricated architectural joint systems capable of withstanding the types of loads and of accommodating the kinds of movement, and the other functions for which they are designed including those specified below, without failure. Types of failure include those listed in Appendix X3 of ASTM E 1399.
1. Pedestrian Traffic Joints: Support pedestrian traffic across joint.
  2. Exterior Joints: Maintain continuity of weather enclosure.
  3. Joints in Fire-Resistance-Rated Assemblies: Maintain fire-resistance ratings of assemblies.
  4. Joints in Smoke Barriers: Maintain integrity of smoke barrier.
  5. Joints in Acoustically Rated Assemblies: Inhibit passage of airborne noise.
  6. Other Joints: Where indicated, provide joint systems that prevent penetration of water, moisture, and other substances deleterious to building components or content.
  7. Seismic Joints: Remain in place on exposure to seismic activity (movement).
  8. Joints in Surfaces with Architectural Finishes: Serve as finished architectural joint closures.

### 1.5 SUBMITTALS

- A. Product Data: Include manufacturer's product specifications, construction details, material and finish descriptions, and dimensions of individual components and seals.
- B. Shop Drawings: For each joint system specified, provide the following:
1. Placement Drawings: Include line diagrams showing entire route of each joint system, plans, elevations, sections, details, joints, splices, locations of joints and splices, and attachments to other Work. Where joint systems change planes, provide Isometric Drawings depicting how components interconnect to achieve continuity of joint covers and fillers.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each exposed metal and elastomeric material of joint system indicated.
1. Include similar Samples of material for joints and accessories involving color selection.
- D. Product Test Reports: From a qualified testing agency indicating architectural joint systems comply with requirements, based on comprehensive testing of current products.
- E. Research/Evaluation Reports: Evidence of architectural joint system's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
- F. LEED Submittal:
1. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.

### 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain architectural joint systems through one source from a single manufacturer. Coordinate compatibility with adjoining joint systems specified in other Sections.
- B. Fire-Test-Response Characteristics: Where indicated, provide joint systems incorporating fire barriers that are identical to those of assemblies tested for fire resistance per ASTM E 119 and U.L. 2079, including hose-stream test of vertical wall assemblies, by a testing and inspecting agency acceptable to authorities having jurisdiction.

- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of architectural joint systems and are based on the specific systems indicated. Other manufacturers' systems complying with requirements may be considered. Refer to Division 1 Section "Product Requirements."
  - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Products: The design for each architectural joint system indicated in drawings is based on the products named. Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers listed.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers indicated in Part 2 "Architectural Joint Systems" Article.

### 2.2 MATERIALS

- A. Aluminum: ASTM B 221, alloy 6063-T5 for extrusions; ASTM B 209, alloy 6061-T6 for sheet and plate.
  - 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Stainless Steel: ASTM A 666, Type 304 with No. 2B finish, unless otherwise indicated, for plates, sheet, and strips.
- C. Preformed Seals: Single or multicellular extruded elastomeric seals designed with or without continuous, longitudinal, internal baffles. Formed to be installed in frames or with anchored flanges, in color indicated or, if not indicated, as selected by Architect from manufacturer's standard colors.
- D. Strip Seals: Elastomeric membrane or tubular extrusions with a continuous longitudinal internal baffle system throughout complying with ASTM E 1783; used with compatible frames, flanges, and molded-rubber anchor blocks.
- E. Compression Seals: Preformed, elastomeric extrusions having internal baffle system complying with ASTM E 1612 in sizes and profiles indicated or as recommended by manufacturer.
- F. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint.
- G. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesives, and other accessories compatible with material in contact, as indicated or required for complete installations.

### 2.3 ARCHITECTURAL JOINT SYSTEMS

- A. General: Provide joint systems of design, basic profile, materials, and operation indicated. Provide units with the capability to accommodate joint widths indicated and variations in adjacent surfaces.



1. Furnish units in longest practicable lengths to minimize number of end joints. Provide hairline mitered corners where joint changes directions or abuts other materials.
2. Include closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.
3. Frames for Strip Seals: Designed with semiclosed cavity that provides a mechanical lock for seals of type indicated.
4. Public Arena Seals: Non-slip seals designed for installation on treads and risers and to lie flat with adjacent surfaces, and complying with ADA guidelines for public areas.

B. Basis-of-Design Products: As indicated in the following paragraph by MM Systems.

C. Expansion Joint System for Floors: Metal frames and covers for interior pedestrian traffic joints.

1. Basis-of-Design Product: MM Systems type EHFx 2-1 or a comparable product.
2. Nominal Joint Width: 2 inch.
3. Movement Capability: Plus or minus 25 percent.
4. Type of Movement Capability: Expansion and contraction.
5. Exposed Cover Material: Clear anodized aluminum.

D. Expansion Joint System for Gypsum Walls and Ceilings: Metal frames and covers for interior wall joints.

1. Basis-of-Design Product: MM Systems type FX-K 2-1 or a comparable product.
2. Nominal Joint Width: 2 inch.
3. Movement Capability: Plus or minus 1 inch.
4. Type of Movement Capability: Expansion and contraction.
5. Retainer Material: Clear anodized aluminum.

E. Exterior Expansion Joint System: Urethane foam filler for wall joints.

1. Basis-of-Design Product: MM Systems type ESS Wall-to Wall or a comparable product.
2. Nominal Joint Width: 2 inch.
3. Movement Capability: Plus or minus 1 inch.
4. Type of Movement Capability: Expansion and contraction.
5. Material: Preformed silicone sealing strip.

## 2.4 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## 2.5 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

## PART 3 - EXECUTION

### 3.1 COORDINATION

- A. Coordinate construction with locations of building expansion. Expansion space shall be continuous through the entire building as indicated in drawings. Do not close in expansion spaces with joint covers where adjoining construction does not provide required clearances for specified movement capability or where adjacent construction bridges expansion spaces.
  - 1. Provide written notification to the General Contractor, of locations where in-place work that is detrimental to expansion requirements.

### 3.2 PREPARATION

- A. Prepare substrates according to architectural joint system manufacturer's written instructions.
- B. Coordinate and furnish anchorages, Placement Drawings, and instructions for installing joint systems to be embedded in or anchored to concrete or to have recesses formed into edges of concrete slab for later placement and grouting-in of frames.
- C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary to secure joint systems to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

### 3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for handling and installing architectural joint assemblies and materials, unless more stringent requirements are indicated.
- B. Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.
- C. Terminate exposed ends of exterior architectural joint assemblies with factory-fabricated termination devices to maintain waterproof system.
- D. Install factory-fabricated transitions between building expansion-joint cover assemblies and roof expansion-joint assemblies, specified in Division 7 Section "Roof Expansion Assemblies," to provide continuous, uninterrupted, watertight construction.
- E. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required to install joint systems.
  - 1. Install joint cover assemblies in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
  - 2. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling.
  - 3. Set covers in horizontal surfaces at elevations that place exposed surfaces flush with adjoining finishes.
  - 4. Locate wall, ceiling, and soffit covers in continuous contact with adjacent surfaces.
  - 5. Securely attach in place with required accessories.
  - 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.
- F. Continuity: Maintain continuity of joint systems with a minimum number of end joints and align metal members. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames. Adhere flexible filler materials, if any, to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

- G. Extruded Preformed Seals: Install seals to comply with manufacturer's written instructions and with minimum number of end joints.
  - 1. For straight sections, provide preformed seals in continuous lengths.
  - 2. Vulcanize or heat-weld field splice joints in preformed seal material to provide watertight joints using procedures recommended by manufacturer.
  - 3. Apply adhesive, epoxy, or lubricant adhesive approved by manufacturer to both frame interfaces before installing preformed seals.
  - 4. Seal transitions according to manufacturer's written instructions.
  - 5. Install foam seals with adhesive recommended by manufacturer and heat seal all splices.
- H. Joint Systems with Seals: Seal end joints within continuous runs and joints at transitions according to manufacturer's written instructions to provide a watertight installation.
- I. Seismic Seals: Install interior seals in continuous lengths. Install exterior seal in standard lengths and vulcanize or heat-weld field splice joints to provide watertight joints using manufacturer's recommended procedures. Seal transitions and end joints according to manufacturer's written instructions.
- J. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and end joints.

#### 3.4 CLEANING AND PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

END OF SECTION 079513

## SECTION 081100 - STEEL DOORS AND FRAMES

## PART 1 - GENERAL

## 1.01 RELATED DOCUMENTS

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

## 1.02 SUMMARY

- A. This Section includes the following:

- 1. Steel doors.
- 2. Steel frames.

- B. Related Sections include the following:

- 1. Division 04 Section "Unit Masonry Assemblies" for building anchors into and grouting steel frames in masonry construction.
- 2. Division 08 Section "Glazing" for glazed lites in steel doors and frames.
- 3. Division 08 Sections for door hardware and weatherstripping for steel doors.
- 4. Division 09 painting Sections for field painting steel doors and frames.
- 5. Division 26 for electrical service and connections of electrified door hardware and controls.

## 1.03 DEFINITIONS

- A. Minimum Steel Sheet Thickness: Minimum thickness of base metal without coatings.

## 1.04 SUBMITTALS

- A. General: Submit in accordance with Section 013300.

- 1. Submittals for Sections 081100, 082110, and 087100 shall be made concurrently.

- B. Product Data: Include door designation, type, level and model, construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, and finishes for each type of hollow-metal door and frame specified.

- C. Shop Drawings: In addition to requirements below, provide a schedule of steel doors and frames using same reference numbers for details and openings as those on Drawings:

- 1. Elevations of each door design.
- 2. Details of doors, including vertical and horizontal edge details.
- 3. Frame details for each frame type, including dimensioned profiles.
- 4. Details and locations of reinforcement and preparations for hardware.
- 5. Details of each different wall opening condition.
- 6. Details of anchorages, accessories, joints, and connections.
- 7. Details of glazing frames and stops showing glazing.
- 8. Details of conduit and preparations for electrified door hardware and controls.

- D. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.

- E. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing

agency, for each type of steel door and frame.

- F. Material Certificates: Signed by manufacturers certifying that each fire-rated door complies with requirements.

#### 1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain steel doors and frames through one source from a single manufacturer.
- B. Fire-Rated Door, Sidelight and Transom Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.
  - 1. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 10C.
- C. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Inspect doors and frames on delivery for damage; notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.
- D. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
  - 1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1 /4-inch space between each stacked door to permit air circulation.

#### 1.07 COORDINATION

- A. Coordinate installation of anchorages for steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in masonry. Deliver such items to Project site in time for installation.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ceco Door Products; a United Dominion Company.
  - 2. CURRIES Company; an ASSA ABLOY Group Company.
  - 3. Steelcraft; an Ingersoll-Rand Company.

#### 2.02 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 101 I/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 zinc-iron-alloy (galvannealed) coating designation.
- D. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.
- F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching standard steel doorframes of type indicated.
- G. Grout: Comply with Division 04 Section "Unit Masonry."
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.
- I. Glazing: Comply with requirements in Division 08 Section "Glazing."
- J. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

### 2.03 STEEL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8, unless more stringent requirements are specified.
  - 1. Design: Flush panel.
  - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board with internal sound deadener on inside of face sheets, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.
    - a. Fire Door Core: As required to provide fire-protection ratings indicated.
    - b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 11.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363, unless otherwise indicated.
- I) Locations: Exterior doors.
- 3. Vertical Edges for Doors: Beveled edge.
  - a. Beveled Edge: 1/8 inch in 2 inches.
- 4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick end closures or channels of same material as face sheets.
- 5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior door requirements. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).
    - a. All doors in Locker Room areas shall be fabricated from metallic-coated steel sheet.
- D. Hardware Reinforcement: Fabricate reinforcement plates of sufficient strength from same material as door face sheets to support hardware without through bolting and to comply with the following minimum sizes:
1. Hinges: Minimum 0.123 inch thick (10 gage) by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
  2. Pivots: Minimum 0.167 inch thick (8 gage) by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
  3. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch thick (8 gage).
  4. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick (8 gage).
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

#### 2.04 STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
  2. Frames for Level 3 Steel Doors: 0.067-inch- thick (14 gage) steel sheet, unless otherwise indicated.
- C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.
1. Fabricate frames with mitered or coped and welded face corners and seamless face joints, unless otherwise indicated.
  2. Frames for Level 2 Steel Doors: 0.053-inch- thick (16 gage) steel sheet, unless otherwise indicated.
    - a. Frames for doors in Locker Room areas shall be fabricated from metallic-coated steel sheet.
  3. Frames for Wood Doors: 0.053-inch- thick (16 gage) steel sheet, unless otherwise indicated.
  4. Frames for Borrowed Lights: 0.042-inch- thick (18 gage) steel sheet, unless otherwise indicated.
  5. AH welded joints shall be ground and dressed to be smooth, flush, and invisible.
- D. Hardware Reinforcement: Fabricate reinforcement plates of sufficient strength from same material as frames to support hardware without through bolting and to comply with the following minimum sizes:
1. Hinges: Minimum 0.123 inch thick (10 gage) by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
  2. Pivots: Minimum 0.167 inch thick (8 gage) by 1-1/2 inches wide by 6 inches longer than hinge,

- secured by not less than 6 spot welds.
3. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch thick (14 gage).
  4. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick (14 gage).
  5. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.
- E. Supports and Anchors: Fabricated from not less than 0.042-inch thick (18 gage) electrolytic zinc-coated or metallic-coated steel sheet.
- F. Jamb Anchors:
1. Masonry Type: T-shaped anchors to suit frame size, not less than 0.042 inch thick (18 gage).
  2. Metal Stud-Wall Type: Slip in wood stud anchor equal to Curries M series; not less than 0.053 inch thick (16 gage).
- G. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick (18 gage), and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
- H. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.
- I. Plaster Guards: Formed from same material as frames, not less than 0.016-inch thick (28 gage) steel sheet to close off interior of openings; place at back of hardware cutouts where mortar or other materials might obstruct hardware operation.
- 2.05 STOPS AND MOLDINGS
- A. Moldings for Glazed Lites in Doors: Minimum 0.012 inch thick (20 gage), fabricated from same material as door face sheet in which they are installed.
1. Provide non-removable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
  2. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.
- B. Fixed Frame Moldings: Formed integral with steel frames, minimum 5/8 inch high, unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick (20 gage), fabricated from same material as frames in which they are installed.
- D. Astragals: As required by NFPA 80 to provide fire ratings indicated.

2.06 FABRICATION

- A. General: Fabricate steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Steel Doors:
1. Exterior Doors: For exterior locations and elsewhere as indicated, fabricate doors, panels, and frames from metallic-coated steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053-inch-thick (16 gage), metallic-coated steel channels with channel webs placed even with top and bottom edges. Seal joints in top edges of doors against water penetration.



2. Interior Door and Panel Faces: Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from cold-rolled steel sheet, unless otherwise indicated.
  3. Glazed Lites: Factory cut openings in doors.
  4. Wipe Coat Galvanneal Doors will not be considered acceptable
- C. Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
  2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints; fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding; grind smooth and invisible.
  3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
  4. Plaster Guards: Weld guards to frame at back of hardware mortises in frames installed in concrete or masonry.
  5. Where installed in masonry, leave vertical mullions in frames open at top for grouting.
  6. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor. Provide floor anchors for all frames.
  7. Jamb Anchors: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
    - a. Masonry Type:
      - 1) Two anchors per jamb up to 60 inches in height.
      - 2) Three anchors per jamb from 60 to 90 inches in height.
      - 3) Four anchors per jamb from 90 to 120 inches in height.
      - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 120 inches in height.
    - b. Stud-Wall Type:
      - 1) Three anchors per jamb up to 60 inches in height.
      - 2) Four anchors per jamb from 60 to 90 inches in height.
      - 3) Five anchors per jamb from 90 to 96 inches in height.
      - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.
      - 5) Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
  8. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
  9. Provide welded frames with temporary spreader bars for shipping.
- D. Hardware Preparation: Factory prepare standard steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Reinforce doors and frames to receive nontemplated mortised and surface-mounted door hardware. Through bolting will not be acceptable.
  2. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A1 15 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on Shop Drawings or, if not

indicated, according to ANSI A250.8.

- E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form comers of stops and moldings with butted or mitered hairline joints.
  - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of door or frame.
  - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings such that each glazed lite is capable of being removed independently.
  - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  - 4. Provide loose stops and moldings on inside of doors and frames.
  - 5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.
- F. Astragals: As required by NFPA 80 to provide fire ratings indicated.

## 2.07 STEEL FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - I. Apply primers to steel doors and frames after assembly.
- B. Comply with SSPC-PA1, "Paint Application Specification No. 1," for steel sheet finishes.
- C. Metallic-Coated Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
  - 1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- D. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- E. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.
  - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.
  - 2. Wiped Coat Galvanneal Frames will not be considered acceptable.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of steel doors and frames.
  - 1. Examine roughing-in for embedded and built-in anchors to verify actual locations of steel frame

- connections before frame installation.
2. If unacceptable conditions are encountered, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

A. Remove welded-in shipping spreaders installed at factory.

B. Paint backside of frames to be set in masonry with bituminous coating.

C. Prior to installation, adjust and securely brace steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

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

D. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

### 3.03 INSTALLATION

A. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Steel Frames: Install standard steel frames for doors, sidelights, transoms borrowed lights, and other openings, of size and profile indicated. Comply with SDI 105.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
  - a. At fire-protection-rated openings, install frames according to NFPA 80.
  - b. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
  - c. Install frames with removable glazing stops located on secure side of opening.
  - d. Install door silencers in frames before grouting.
  - e. Remove shipping straps at bottom of frames. Properly space frame using wood template that is full depth of frame and of proper spacing width during setting and anchoring of frames to maintain proper width, with frame plumb and square without twists. Remove temporary braces necessary for installation only after frames have been properly set and secured.
  - f. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
  - g. Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors. Floor anchors are in addition to wall anchors.
  - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Attach wall anchors to studs with screws. Provide floor anchor at each jamb, in addition to the wall anchors.
  4. Masonry Walls: Anchors shall be masonry T-shaped anchors. Provide floor anchor at each jamb, in addition to the wall anchors. Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 04 Section "Unit Masonry."
  5. Installation Tolerances: Adjust steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
  6. Mineral Fiber Insulation: Fill head and jambs of frames scheduled to receive sound seals with mineral fiber insulation.
- C. Steel Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
    - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
  2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
  3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with steel door and frame manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.
- 3.04 ADJUSTING AND CLEANING
- A. Final Adjustments: Remove and replace defective work, including steel doors or frames that are warped, bowed, or otherwise unacceptable.
  - B. Clean grout and other bonding material off steel doors and frames immediately after installation.
  - C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

END OF SECTION 081100

## SECTION 082110 – WOOD DOORS

## PART 1 - GENERAL

## 1.01 RELATED DOCUMENTS

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

## 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Solid-core doors with wood-veneer faces.
  - 2. Interior stile and rail doors.
  - 3. Factory finishing wood doors.
  - 4. Factory fitting wood doors to frames and factory machining for hardware.
  - 5. Factory glazing of wood door.
- B. Related Sections include the following:
  - 1. Division 8 Section "Glazing" for glass types.

## 1.03 SUBMITTALS

- A. General: Submit in accordance with Section 013300.
  - 1. Submittals for Sections 081100, 082110, and 087100 shall be made concurrently.
- B. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications. Submit door manufacturer's storage, handling, finish, installation, and maintenance instructions.
- C. Shop Drawings: Indicate location, size, and hand of each door, elevation of each kind of door; face veneer, construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
  - 1. Indicate dimensions and locations of mortises and holes for hardware.
  - 2. Indicate dimensions and locations of cutouts.
  - 3. Indicate requirements for veneer matching.
  - 4. Indicate doors to be factory finished and finish requirements.
  - 5. Indicate fire ratings for fire doors.
  - 6. Indicate doors to be factory glazed.
- D. Door Schedule: Submit schedule of doors using same reference numbers for details and openings as those on Contract Drawings.
  - 1. Indicate coordination of glazing frames and stops with glass and glazing requirements.
- E. Samples: Submit the following:
  - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
  - 2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edgings representing typical range of color and grain for each species of veneer and solid lumber required. Finish sample with same materials proposed for factory-finished doors.
  - 3. Frames for light openings, 6 inches long, for each material, type, and finish required.
- F. LEED Submittals:
  - a. Certificates for Credit MR7: Provide manufacturer's Chain-of-custody certificate,

issued by an FSC-accredited certifying body, certifying that flush wood doors comply with forest certification requirements of the Forest Stewardship Council.

- b. Include a statement indicating FSC product claim and the cost of each certified wood product. Statement must additionally include the total cost of all wood products supplied.
- c. Provide wood door distributors chain-of-custody certificate.

#### 1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors and interior stile and rail doors through one source from a single manufacturer.
- B. Manufacturer Qualifications: A qualified manufacturer must be certified for chain-of-custody by a FSC-accredited certification body. Wood door distributor must be shown in chain-of-custody.
- B. Quality Standard: Comply with NWWDA I.S. 1-A, "Architectural Wood Flush Doors" or AWI's "Architectural Woodwork Quality Standards Illustrated."
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
  - 1. Test Pressure: Test at atmospheric pressure.
  - 2. Acceptable Fire-Rating Label: Underwriters' Laboratories, Inc. (U.L.) or Warnock Hersey.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect wood doors during transit, storage, and handling to prevent damage, soiling and deterioration. Comply with requirements of referenced standard, manufacturer's instructions, and recommendations of NWWDA I.S. I, Appendix, "How to Store, Handle, Finish, Install and Maintain Wood Doors."
  - 1. Package doors at factory prior to shipping.
  - 2. Protect doors from extremes of heat and cold. Relative humidity shall not be less than 30 percent no more than 60 percent.
  - 3. Compare pre-finished doors to approved finish sample upon delivery. Notify Architect if sample does not match.
- B. Mark each door on top and bottom rail with opening number used on Shop Drawings.

#### 1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

#### 1.07 WARRANTY

- A. General: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or

workmanship, have warped (bow, cup, or twist), show telegraphing of core construction in face veneers, and which do not conform to tolerance limitations of specified quality standards.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
2. Warranty shall be in effect during the following period of time from date of Substantial Completion:
  - a. Solid-Core Interior Doors: Life of installation.
  - b. Interior Stile and Rail Doors: Life of installation.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

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

1. Wood Doors:
  - a. Algoma Hardwoods Inc.
  - b. Eggers Industries; Architectural Door Division
  - c. Marshfield Door Systems
  - d. VT Industries Inc.

### 2.02 DOOR CONSTRUCTION, GENERAL

- A. Doors for Transparent Finish:
1. Grade: Premium, with Grade A faces.
  2. Species and Cut: Select white birch, rotary cut.
  3. Match between Veneer Leaves: Book match.
  4. Assembly of Veneer Leaves on Door Faces: Running match.
  5. Match: Provide door faces of compatible color and grain for doors hung in same opening or separated only by mullions.
  6. Stiles: Same species as faces or a compatible species.

### 2.03 SOLID-CORE DOORS

- A. Particleboard Cores: Comply with the following requirements:
1. Particleboard: ANSI A208.1, Grade LD-2.
  2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
  3. Provide stile and rail doors with structural composite lumber cores.
- B. Interior Veneer-Faced Doors:
1. Core: Particleboard for flush doors; structural composite lumber core for stile and rail doors.
  2. Construction: Five plies, hot pressed, with stiles and rails bonded to core, then entire unit abrasive planed before veneering.
    - a. No substitution.
- C. Fire-Rated Doors:
1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
  2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as needed to eliminate through-bolting hardware.
  3. Edge Construction: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.

4. Pairs: Provide fire-rated pairs with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals.
5. Glazing shall be fire rated wire glass not acceptable.

#### 2.04 LIGHT FRAMES

- A. Wood Frames for Light Openings in Doors: Flush, solid wood or veneer wrapped, of same species as door facing, mitered corners, factory glazed.

#### 2.05 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
  - I. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DH1-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI AI 15-W series standards, and hardware templates.
  1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
  1. Light Openings: Trim factory glazed openings with moldings of material and profile indicated.

#### 2.06 FACTORY FINISHING

- A. General: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated," Section 1500 for factory finishing.
- B. Finish doors at factory.
- C. Transparent Finish:
  1. Grade: Custom.
  2. Finish: AWI System, TR-6 catalyzed polyurethane.
  3. Staining: None required.
  4. Sheen: Satin.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
  1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.02 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
  1. Hinges shall be shimmed with metal shims at each door to provide equal clearance at



- each jamb.
- 2. Locks, exit devices, door closers and other hardware shall be installed in accordance with the manufacturer's instructions. Pilot holes of recommended size, for wood screws required to fasten the hardware, shall be drilled by the installing Contractor before screws are fastened to the wood doors.
- B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
  - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

### 3.03 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 082110

## SECTION 083113 - ACCESS DOORS AND FRAMES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Access doors and frames for walls and ceilings.
- B. Related Sections include the following:
  - 1. Division 04 Section "Unit Masonry" for anchoring and grouting access door frames set in masonry construction.
  - 2. Division 07 Section "Roof Accessories" for roof hatches.
  - 3. Division 23 Section "Air Duct Accessories" for heating and air-conditioning duct access doors.

## 1.3 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated. Include construction details, materials, individual components and profiles, and finishes.
- B. LEED Submittal:
  - 1. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
- C. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.
- D. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.
- E. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

## 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain access doors and frames through one source from a single manufacturer.
- B. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

## 1.5 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

## PART 2 - PRODUCTS

### 2.1 STEEL MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
  - 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
  - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- C. Steel Sheet: Uncoated cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- D. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
  - 2. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.

### 2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Acudor Products, Inc.
  - 2. Babcock-Davis; A Cierra Products Co.
  - 3. Bar-Co, Inc. Div.; Alfab, Inc.
  - 4. Dur-Red Products.
  - 5. J. L. Industries, Inc.
  - 6. Karp Associates, Inc.
  - 7. Larsen's Manufacturing Company.
  - 8. Milcor Inc.
  - 9. Nystrom, Inc.
  - 10. Williams Bros. Corporation of America (The).
- B. Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
  - 1. Locations: Wall and ceiling surfaces.
  - 2. Door: Minimum 0.060-inch- thick sheet metal, set flush with exposed face flange of frame.
  - 3. Frame: Minimum 0.060-inch- thick sheet metal with 1-inch- wide, surface-mounted trim.

4. Hinges: Continuous piano.
5. Latch: Cam latch operated by screwdriver with interior release.

### 2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
  1. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
  2. Provide mounting holes in frames for attachment of units to metal or wood framing.
  3. Provide mounting holes in frame for attachment of masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

### 3.2 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

## SECTION 083323 - OVERHEAD COILING DOORS

## 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. Service doors.
- 2. Fire-rated service doors.

- B. Related Sections:

- 1. Division 05 Section "Metal Fabrications" for miscellaneous steel supports.
- 2. Division 26 Sections for electrical service and connections for powered operators and accessories.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
  - 2. Seismic Component Importance Factor: 1.0.
- C. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

## 1.4 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:
  - 1. Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
  - 2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
  - 3. For fire-rated doors, description of fire-release system including testing and resetting instructions.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  2. Show locations of replaceable fusible links.
  3. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
1. Include similar Samples of accessories involving color selection.
- D. Delegated-Design Submittal: For overhead coiling doors 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. Detail fabrication and assembly of seismic restraints.
  2. Summary of forces and loads on walls and jambs.
- E. Seismic Qualification Certificates: For overhead coiling doors, accessories, and components, from manufacturer.
- F. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
1. Obtain operators and controls from overhead coiling door manufacturer.
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.
1. Smoke Control: In corridors and smoke barriers, provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UBC Standard 7-2; with maximum air-leakage rate of 3.0 cfm/sq. ft. of door opening at 0.10 inch wg for both ambient and elevated temperature tests.
- D. 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.

## PART 2 - PRODUCTS

### 2.1 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch and as required to meet requirements.
  2. Aluminum Door Curtain Slats: ASTM B 209 sheet or ASTM B 221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch and as required to meet requirements.
- B. Endlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
- C. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.
- D. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- E. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

## 2.2 HOOD

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
1. Galvanized Steel: Nominal 0.028-inch- thick, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653/A 653M.
  2. Aluminum: 0.040-inch- thick aluminum sheet complying with ASTM B 209, of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
  3. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

## 2.3 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

## 2.4 CURTAIN ACCESSORIES

- A. Smoke Seals: Equip each fire-rated door with smoke-seal perimeter gaskets for smoke and draft control as required for door listing and labeling by a qualified testing agency.
- B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

1. Provide pull-down straps or pole hooks for doors more than 84 inches high.
- C. Automatic-Closing Device for Fire-Rated Doors: Equip each fire-rated door with an automatic-closing device that is inoperative during normal door operations and that has a governor unit complying with NFPA 80 and an easily tested and reset release mechanism designed to be activated by the following:
1. Building fire-detection and -alarm systems and manufacturer's standard door-holder-release devices.

## 2.5 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.6 MANUAL DOOR OPERATORS

- A. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.
- B. Push-up Door Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed 25 lbf.

## 2.7 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
1. Comply with NFPA 70.
  2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.



- C. Door Operator Location: Operator location indicated for each door.
  - 1. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
- D. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 11 Section "Common Motor Requirements for Equipment" unless otherwise indicated.
  - 1. Electrical Characteristics:
    - a. Phase: Single phase.
    - b. Volts: 115 V.
    - c. Hertz: 60.
  - 2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
  - 3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
  - 4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
  - 5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
  - 1. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- G. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

## 2.8 DOOR ASSEMBLY

- A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cookson Company.
    - b. Cornell Iron Works, Inc.
    - c. McKeon Rolling Steel Door Company, Inc.
    - d. Metro Door.

- e. Overhead Door Corporation.
  - f. Raynor.
  - g. Wayne-Dalton Corp.
- B. Operation Cycles: Not less than 20,000.
- C. Door Curtain Material: Aluminum.
- D. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.
- E. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
- F. Hood: Aluminum.
- 1. Shape: Round or square.
  - 2. Mounting: Face of wall.
- G. Electric Door Operator:
- 1. Usage Classification: Light duty, up to 10 cycles per hour.
  - 2. Operator Location: Wall.
  - 3. Motor Exposure: Interior.
  - 4. Emergency Manual Operation: Push-up type.
- H. Door Finish:
- 1. Aluminum Finish: Clear anodized.

## 2.9 FIRE-RATED DOOR ASSEMBLY

- A. Fire-Rated Service Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cookson Company.
    - b. Cornell Iron Works, Inc.
    - c. McKeon Rolling Steel Door Company, Inc.
    - d. Overhead Door Corporation.
    - e. Raynor.
    - f. Wayne-Dalton Corp.
- B. Operation Cycles: Not less than 10,000.
- C. Fire Rating: 1-1/2 hours and with smoke control.
- D. Door Curtain Material: Galvanized steel.
- E. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.
- F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

- G. Hood: Galvanized steel.
  - 1. Shape: Round or square.
  - 2. Mounting: Between jambs.
- H. Manual Door Operator: Push-up operation.
  - 1. Provide operator with through-wall shaft operation.
  - 2. Provide operator with manufacturer's standard removable operating arm.
- I. Door Finish:
  - 1. Factory Prime Finish: Manufacturer's standard color.

## 2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.11 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## 2.12 STEEL AND GALVANIZED-STEEL FINISHES

- A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

- B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Fire-Rated Doors: Install according to NFPA 80.
- E. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

### 3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Perform installation and startup checks according to manufacturer's written instructions.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

### 3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

### 3.6 SCHEDULE

- A. Doors 104B and 104C: Provide aluminum service door, electrically operated.
- B. Door 203A: Provide steel, fire rated service door, manually operated.

END OF SECTION 083323

## SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

## 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. Exterior and interior storefront framing.
  - 2. Storefront framing for window walls.
  - 3. Exterior and interior manual-swing entrance doors and door-frame units.

## 1.3 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

## 1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
  - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
  - 2. Dimensional tolerances of building frame and other adjacent construction.
  - 3. Failure includes the following:
    - a. Deflection exceeding specified limits.
    - b. Thermal stresses transferring to building structure.
    - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
    - d. Noise or vibration created by wind and by thermal and structural movements.
    - e. Loosening or weakening of fasteners, attachments, and other components.
    - f. Sealant failure.
    - g. Failure of operating units.
- B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:
  - 1. Wind Loads: As indicated on Structural Drawings..

2. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - a. Component Importance Factor is 1.0.
- D. Deflection of Framing Members:
  1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed  $L/175$  of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to  $3/4$  inch, whichever is less.
  2. Deflection Parallel to Glazing Plane: Limited to  $L/360$  of clear span or  $1/8$  inch, whichever is smaller.
- E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
  1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..
- G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
  1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.
- H. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
    - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
    - b. Low Exterior Ambient-Air Temperature: 0 deg F.
  2. Interior Ambient-Air Temperature: 75 deg F.
- I. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.
- J. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.45 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.
- B. LEED Submittal:
  - 1. Product Data for Credit EQ 4.1: For adhesives and sealants used inside of the weatherproofing system, including printed statement of VOC content.
  - 2. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
- C. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
  - 2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Other Action Submittals:
  - 1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- F. Delegated-Design Submittal: For aluminum-framed systems 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. Detail fabrication and assembly of aluminum-framed systems.
  - 2. Include design calculations.
- G. Seismic Qualification Certificates: For aluminum-framed systems, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.
- I. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
- J. Warranties: Sample of special warranties.

## 1.6 QUALITY ASSURANCE

- A. **Installer Qualifications:** Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. **Engineering Responsibility:** Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- C. **Product Options:** Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
  - 1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- D. **Accessible Entrances:** Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
- E. **Source Limitations for Aluminum-Framed Systems:** Obtain from single source from single manufacturer.
- F. **Regulatory Requirements:** Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.
  - 1. **Doors:** Provide doors as required by accessibility regulations and requirements of authorities having jurisdiction. These include, but are not limited to, the following:
    - a. **Clear Width:** 32 inches (815 mm) with door 90 degrees open.
    - b. **Maneuvering Clearances:** Refer to Code for various side and approach clearances.
    - c. **Double-Leaf Doorways:** Provide at least one leaf that meets the clear width and maneuvering clearances.
    - d. **Two Doors in Series:** Provide a distance of four feet plus the width of any door swinging into the space between hinged or pivoted doors.
  - 2. Notify Architect of details or specifications not conforming to code.
- G. **Preinstallation Conference:** Conduct conference at Project site.
  - 1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
  - 2. Review structural loading limitations.
  - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review tie-in to air barrier system.
  - 5. Review sill flashing details and components.
  - 6. Review coordination with electrical or additional hardware provided by others.

## 1.7 PROJECT CONDITIONS

- A. **Field Measurements:** Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.



## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Noise or vibration caused by thermal movements.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - d. Water leakage through fixed glazing and framing areas.
    - e. Failure of operating components.
  2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide indicated products by one of the following:
1. EFCO Corporation.
  2. Kawneer North America; an Alcoa company.
  3. United States Aluminum.
  4. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
- B. Products:
1. Exterior Aluminum-Framed Storefronts:
    - a. Kawneer: Trifab VG 451 T.
    - b. EFCO: System 403.
    - c. U.S. Aluminum: Series IT451.
    - d. Vistawall: 3000 Thermal MultiPlane.
  2. Interior Aluminum-Framed Storefronts:
    - a. Kawneer: Trifab VG 451.
    - b. EFCO: System 402.
    - c. U.S. Aluminum: Series 451.
    - d. Vistawall: 3000 non-thermal MultiPlane.
  3. Exterior Aluminum Windows:
    - a. Kawneer: Trifab VG 451 T

- b. EFCO: System 403.
  - c. U.S. Aluminum: Series FT451
  - d. Vistawall: 3000 Thermal MultiPlane
4. Doors and Entrances:
- a. Kawneer: 500 Heavy Wall
  - b. EFCO: Series D518 DuraStile
  - c. U.S. Aluminum: Series 850 Durafront
  - d. Vistawall: Rugged WS

## 2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
- 1. Sheet and Plate: ASTM B 209.
  - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
  - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
  - 4. Structural Profiles: ASTM B 308/B 308M.
  - 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
- 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  - 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  - 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

## 2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
- 1. Construction: Nonthermal for interior construction, thermally broken for exterior construction.
  - 2. Glazing System: Retained mechanically with gaskets on four sides.
  - 3. Glazing Plane: Center.
  - 4. Exterior Jambs and Head Framing: Provide manufacturer's standard extruded aluminum continuous flat filler for use at jambs and head framing. This extrusion provides the necessary profile for sealing with the building air barrier system. Channel type jamb components will not be acceptable.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
- 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  - 2. Reinforce members as required to receive fastener threads.

3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system, fabricated from stainless steel.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
  1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Subsills for Exterior Storefronts: Manufacturer's standard thermally broken extruded aluminum sill flashing, color to match framing.

## 2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

## 2.5 ENTRANCE DOOR SYSTEMS

- A. Heavy-Duty Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
  1. Door Construction: 1-7/8 to 2-inch overall thickness, with minimum 0.188-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
  2. Door Design: Wide stile; 5-inch nominal width.
    - a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.
  3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
- B. Entrance Door Hardware: As specified in Division 08 Section "Door Hardware."

## 2.6 ENTRANCE DOOR HARDWARE

- A. General: Provide entrance door hardware and entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article for each entrance door to comply with requirements in this Section.
  1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products or products equivalent in function and comparable in quality to named products.

2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:
  - a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbfto set the door in motion and not more than 15 lbf to open the door to its minimum required width.
  - b. Accessible Interior Doors: Not more than 5 lbf to fully open door.
- B. Butt Hinges: BHMA A156.1, Grade 1, radius corner.
  1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
  2. Quantities:
    - a. For doors up to 87 inches high, provide 3 hinges per leaf.
    - b. For doors more than 87 and up to 120 inches high, provide 4 hinges per leaf.
- C. Deadlatch: Adams Rite 4510 Series Deadlatch with 4560 handle.
- D. Weather Stripping: Manufacturer's standard replaceable components.
  1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
- E. Silencers: BHMA A156.16, Grade 1.
- F. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.
- G. Cylinders and Additional Hardware: As specified in Division 8 Section "Door Hardware."

## 2.7 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."
  1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

## 2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
  1. Profiles that are sharp, straight, and free of defects or deformations.
  2. Accurately fitted joints with ends coped or mitered.

3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from exterior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
1. At exterior doors, provide compression weather stripping at fixed stops.
  2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
  2. At exterior doors, provide weather sweeps applied to door bottoms.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## 2.10 HARDWARE FINISHES

- A. Standard: BHMA A156.18, as indicated in door hardware sets.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide the following finishes:

- |    |                  |          |
|----|------------------|----------|
| 1. | Weatherstripping | Aluminum |
| 2. | Threshold        | Aluminum |

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

##### A. General:

- 1. Comply with manufacturer's written instructions.
- 2. Do not install damaged components.
- 3. Fit joints to produce hairline joints free of burrs and distortion.
- 4. Rigidly secure nonmovement joints.
- 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
- 6. Seal joints watertight unless otherwise indicated.

##### B. Metal Protection:

- 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
- 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

##### C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

##### D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

##### E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

##### F. Install glazing as specified in Division 08 Section "Glazing."

##### G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

- 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
- 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible. Provide Rivnuts for fastening hardware.

##### H. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

### 3.3 ERECTION TOLERANCES

- A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
  - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
  - 2. Alignment:
    - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
    - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

### 3.4 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
  - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.

### 3.5 SCHEDULE

- A. Exterior Doors: Provide weatherstripping and thresholds for all exterior doors.
- B. Interior Vestibule Doors: Provide silencers and thresholds for all interior vestibule doors.
- C. Cylinders and Additional Hardware: As specified in Division 8 Section "Door Hardware."

END OF SECTION 084113

## SECTION 085200 - WOOD WINDOWS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes fixed and operable wood-framed windows of the following type:
  - 1. Aluminum clad.

## 1.3 DEFINITIONS

- A. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:
  - 1. AW: Architectural.
  - 2. HC: Heavy Commercial.
  - 3. C: Commercial.
  - 4. LC: Light Commercial.
  - 5. R: Residential.
- B. Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:
  - 1. Design pressure number in pounds force per square foot used to determine the structural test pressure and water test pressure.
- C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.
- D. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

## 1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide wood windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified and that are of test size indicated below:
  - 1. Minimum size required by AAMA/WDMA 101/I.S.2.
- B. AAMA/WDMA Performance Requirements: Provide wood windows of the performance class and grade indicated that comply with AAMA/WDMA 101/I.S.2.
  - 1. Performance Class and Grade: As indicated.



## 1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of wood window indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:
  - 1. Mullion details, including reinforcement and stiffeners.
  - 2. Joinery details.
  - 3. Expansion provisions.
  - 4. Flashing and drainage details.
  - 5. Weather-stripping details.
  - 6. Thermal-break details.
  - 7. Glazing details.
- C. Samples for Selection: For units with factory-applied color finishes.
  - 1. Include similar Samples of hardware and accessories involving color selection.
- D. Product Schedule: For wood windows. Use same designations indicated on Drawings.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type, class, grade, and size of wood window. Test results based on use of downsized test units will not be accepted.
- F. Maintenance Data: For operable window sash, operating hardware, weather stripping and finishes to include in maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating wood windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.
- B. Source Limitations: Obtain wood windows through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of wood windows and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements." Do not modify size and dimensional requirements.
  - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Fenestration Standard: Comply with AAMA/WDMA 101/I.S.2/NAFS, "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors," for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
  - 1. Provide WDMA-certified wood windows with an attached label.

- E. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.
- F. Sample Installation: Before installing window units, install a sample window to demonstrate installation procedure. Install to comply with the following requirements, using materials indicated for the completed Work:
  - 1. Coordinate the presence of Architect, Owner, window manufacturer representative, and air barrier manufacturer representative.
  - 2. Review, discuss, and coordinate the interrelationship of windows with other exterior wall components. Include provisions for structural anchorage, glazing, flashing, weeping, sealants, and protection of finishes.
  - 3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
  - 4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.
  - 5. Approval of sample is for relationship of window with air barrier installation; and aesthetic qualities of workmanship.
  - 6. Approved sample may become part of the completed Work if undisturbed at time of Substantial Completion.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to wood windows including, but not limited to, the following:
  - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review sample installation, discuss, and coordinate the interrelationship of wood windows with other exterior wall components. Include provisions for structural anchorage, glazing, flashing, weeping, sealants, and protection of finishes.
  - 3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
  - 4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

## 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify wood window openings by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating wood windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure to meet performance requirements.

- b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
  - c. Faulty operation of movable sash and hardware.
  - d. Deterioration of wood, metals, vinyl, other materials, and finishes beyond normal weathering.
  - e. Failure of insulating glass.
2. Warranty Period:
- a. Window: Ten years from date of Substantial Completion.
  - b. Glazing: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Aluminum-Clad Wood Windows:
    - a. EAGLE Window & Door, Inc.; an American Architectural Products Corporation Company.
    - b. Marvin Windows and Doors.
    - c. Pella Corporation.

### 2.2 MATERIALS

- A. Wood: Clear ponderosa pine or another suitable fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch deep by 2 inches wide; water-repellent preservative treated.
- B. Aluminum Extrusions and Rolled Aluminum for Cladding: Manufacturer's standard formed sheet or extruded-aluminum cladding, mechanically bonded to exterior exposed wood members. Provide aluminum alloy and temper recommended by wood window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength, and not less than 16,000-psi minimum yield strength.
1. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  2. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  3. High-Performance Organic Finish for Extrusions and Sheet: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

- 1) Color and Gloss: As selected by Architect from manufacturer's full range.
- C. Wood Trim and Glazing Stops: Material and finish to match frame members.
  - D. Clad Trim and Glazing Stops: Hollow extrusions or roll-formed sheet material and finish to match clad frame members.
  - E. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with wood window members, cladding, trim, hardware, anchors, and other components.
    1. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.
  - F. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
  - G. Reinforcing Members: Aluminum, or nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
  - H. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when wood window is closed.
    1. Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/WDMA 101/I.S.2/NAFS.
  - I. Sliding-Type Weather Stripping: Provide woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701/702.
    1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.
  - J. Replaceable Weather Seals: Comply with AAMA 701/702.

## 2.3 WINDOWS

- A. Window Type: Fixed, double-hung and projected awning.
- B. AAMA/WDMA Performance Requirements: Provide wood windows of performance indicated that comply with AAMA/WDMA 101/I.S.2/NAFS.
  1. Performance Class and Grade: C40.
- C. Life-Cycle Testing: Test according to AAMA 910 and comply with AAMA/WDMA 101/I.S.2/NAFS.
- D. Operating Force and Auxiliary (Durability) Tests: Comply with AAMA/WDMA 101/I.S.2/NAFS for operating window types indicated.

## 2.4 GLAZING

- A. Glass: Clear, insulating-glass units, with low-E2 coating. Basis-of-Design glazing is LoE2-270- #2/Clear by Cardinal IG.
1. Visible Light Transmission: 70%.
  2. Overall Window U: 0.32.
  3. Overall Window SHGC: 0.29.

## 2.5 HARDWARE

- A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with wood and aluminum cladding; designed to smoothly operate, tightly close, and securely lock wood windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals. Where exposed, provide extruded, cast, or wrought aluminum or nonmagnetic stainless steel.
- B. Counterbalancing Mechanism: Comply with AAMA 902.
1. Sash-Balance Type: Concealed, spring-loaded, block-and-tackle type, of size and capacity to hold sash stationary at any open position.
- C. Locks and Latches: Designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
- D. Gear-Type Rotary Operators: Comply with AAMA 901 when tested according to ASTM E 405, Method A.
1. Operation Function: All ventilators move simultaneously and securely close at both jambs without using additional manually controlled locking devices.
- E. Four- or Six-Bar Friction Hinges: Comply with AAMA 904.
1. Locking mechanism and handles for manual operation.
  2. Friction Shoes: Provide friction shoes of nylon or other nonabrasive, nonstaining, noncorrosive, durable material.

## 2.6 INSECT SCREENS

- A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on inside of window and provide for each operable exterior sash or ventilator.
- B. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
1. Aluminum Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet with minimum wall thickness as required for class indicated.
  2. Finish: Manufacturer's standard finish in color to match window.

- C. Glass-Fiber Mesh Fabric: 18-by-14 or 18-by-16 mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration; in the following color. Comply with ASTM D 3656.

- 1. Mesh Color: Charcoal gray.

## 2.7 ACCESSORIES

- A. Simulated Divided Lites: Not required.
- B. Installation Accessories:
  - 1. Provide factory installed vinyl nailing fin.
  - 2. Provide installation brackets in addition to nailing fin.

## 2.8 FABRICATION

- A. Fabricate wood windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
  - 1. Provide windows sizes of standard available sizes without fabricating custom sizes, unless indicated otherwise. Provide windows with dimensions of not less than 2 inches smaller than indicated on the drawings or provide next size larger.
- B. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator, unless otherwise indicated.
- C. Factory machine windows for openings and for hardware that is not surface applied.
- D. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.
- E. Factory-Glazed Fabrication: Except for light sizes in excess of 100 unglazed inches, glaze wood windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 08 Section "Glazing" and with AAMA/WDMA 101/LS.2/NAFS.
- F. Glazing Stops: Provide nailed or snap-on glazing stops coordinated with Division 08 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.
- G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

## 2.9 ACCESSORIES

- A. Membrane Strip Flashing: Pressure-sensitive plastic tape recommended by air barrier manufacturer for sealing around doors, windows, and penetrations in air barrier. Refer to Division 07 Section "Air Barrier Membranes" for flashing material.

## 2.10 WOOD FINISHES

- A. Factory-Primed Windows: Provide manufacturer's standard factory-prime coat on exposed interior wood surfaces.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.
  - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
  - 2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches of opening.
  - 3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
  - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Install membrane strip flashing in accordance with manufacturer's recommendations and details on the drawings.
- B. Install wall membrane flashing around window openings similar to the following:
  - 1. Make approximately 2-1/2 inch long horizontal cut in the air barrier, starting in the bottom corner of the rough window opening. Extend a diagonal cut in the air barrier from the top of each side of the Y out from the top of each side at the top of the rough window opening.
  - 2. Install 12 inch wide strip into the bottom corners of the window opening. Lapping 6 inches up the inside of the rough opening under the air barrier and across the top of the rough window sill opening. Install the same for each side.
  - 3. Install 12 inch wide strip across the bottom of window with the top of the strip 5 inches above bottom of rough opening. Cut along the jambs of the rough opening and fold strip flashing in across the rough window sill and over corner strip flashing. Lap down over air barrier approximately 6 inches.
  - 4. Install 12 inch wide strip at each sides of the rough opening lapping strip flashing 6 inches over wall sheathing. Extend strip flashing 4 inches above top of rough window opening. Extend strip flashing at the bottom of the window opening as well. Cut and fold into sides of rough window opening.
  - 5. Fold up the flap of the air barrier at the top of window and install 12 inch wide strip across the top of window with the bottom of the strip 5 inches below top of rough opening. Cut along the jambs of the rough opening and fold strip flashing in across the rough window head.
  - 6. Fold down the flap of the air barrier at the top of the window and staple in place.

### 3.3 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support with nailing fin and installation brackets, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

### 3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.
- B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 085200



## SECTION 086300 - METAL-FRAMED SKYLIGHTS

## 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. Aluminum-framed pyramid skylights.

## 1.3 SYSTEM DESCRIPTION

- A. Aluminum-framed pyramid skylights: Provide Model PY 88 meeting the following requirements:
  - 1. Size: 8 foot by 8 foot.
  - 2. Pitch: 4:12.
- B. Skylight be engineered, fabricated and assembled to resolve all thrust within its own base frame.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal-framed skylights.
- B. LEED Submittals:
  - 1. Product Data for Credit EQ 4.1: For sealants used inside of the weatherproofing system, including printed statement of VOC content.
- C. Shop Drawings: For metal-framed skylights. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.
  - 2. Include details and calculations to verify self-supporting skylight unit.
  - 3. Include full-size isometric details of each vertical-to-horizontal intersection of assembly, showing the following:
    - a. Joinery including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions.
    - d. Glazing.
    - e. Flashing and drainage.

- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Fabrication Sample: Of each framing intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:
  - 1. Joinery including concealed welds.
  - 2. Anchorage.
  - 3. Expansion provisions.
  - 4. Glazing.
  - 5. Flashing and drainage.
- F. Delegated-Design Submittal: For metal-framed skylights indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- G. Welding certificates.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for metal-framed skylights.
- I. Field quality-control reports.
- J. Warranties: Sample of special warranties.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer to assume engineering responsibility who has specialized in installing metal-framed skylights similar to those indicated for this Project and who is acceptable to manufacturer.
  - 1. Engineering Responsibility: Preparation of data for metal-framed skylights, including Shop Drawings, based on engineering analysis of manufacturer's standard skylights similar to those indicated for this Project.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of skylights that are similar to those indicated for this Project in material, design, and extent.
- C. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for skylights' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including testing conducted by an independent testing agency and in-service performance.
  - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

- F. Structural-Sealant Glazing: Comply with recommendations in ASTM C 1401, "Guide for Structural Sealant Glazing," for joint design and quality-control procedures.
  - 1. Joint designs are reviewed and approved by structural-sealant manufacturer.
  - 2. Quality-control program development and reporting comply with ASTM C 1401 recommendations for material qualification procedures, preconstruction sealant-testing program, and procedures and intervals for fabrication and installation reviews and checks.
  - 3. Perform manufacturer's standard tests for compatibility and adhesion of sealants with each material that will come in contact with sealants.
- G. Provide metal-framed skylights that comply with test-performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard assemblies by a qualified independent testing agency.
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Meetings." Review methods and procedures related to metal-framed skylights including, but not limited to, the following:
  - 1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
  - 2. Review structural load limitations.
  - 3. Review skylight curb structural requirements.
  - 4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 5. Review required testing procedures.
  - 6. Review weather and forecasted weather conditions and procedures for unfavorable conditions.
  - 7. Review protection of adjacent roof areas.
  - 8. Review preparation and other requirements for installing structural silicone sealant.

## 1.6 WARRANTY

- A. Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of metal-framed skylights that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
  - 1. Structural failures.
  - 2. Sealant failures.
  - 3. Failure of systems to meet performance requirements.
  - 4. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 5. Water leakage; defined as uncontrolled water appearing on normally exposed interior surfaces of skylights from sources other than condensation. Water controlled by flashing and gutters and drained back to the exterior and that cannot damage adjacent materials or finishes is not water leakage.
  - 6. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by Wasco Products, Inc., Commercial Division, Sanford, ME (800-388-1181)

## 2.2 PERFORMANCE REQUIREMENTS

- A. General: Provide metal-framed skylights capable of withstanding loads and thermal and structural movements indicated without failure. Failure includes the following:
1. Deflection exceeding specified limits.
  2. Thermal stresses transferred to the building structure.
  3. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing.
  4. Noise or vibration created by thermal and structural movement and wind.
  5. Loosening or weakening of fasteners, attachments, and other components.
  6. Sealant failure.
- B. Deflection Limits: As follows:
1. Deflection of the entire length of framing members in direction normal to glazing plane is limited to 1/175 of clear span.
- C. Lateral Support: Compression flanges of flexural members are laterally braced by cross members with minimum depths equal to 50 percent of flexural member depth and by anchors to the building structure. Glazing material does not provide lateral support.
- D. Structural Loads: Provide metal-framed skylights, including anchorage, capable of withstanding the effects of the following design loads when supporting full dead loads:
1. Wind Loads: 20 psf uplift.
  2. Snow Loads: Balanced flat roof snow load of 43 psf + 25 psf additional drift applied simultaneously to any (2) adjacent sides.
  3. Roof Loads: As follows:
    - a. Concentrated Load: 250 lbf applied to framing members at location that produces the most severe stress or deflection.
  4. Seismic Loads: As indicated.
- E. Structural Performance: Provide metal-framed skylights, including anchorage, capable of withstanding test pressure indicated without material and deflection failures and permanent deformation of structural members exceeding 0.2 percent of span when tested according to ASTM E 330.
1. Test Pressure: 150 percent of positive and negative wind-load design pressures.
  2. Test Duration: As required by design wind velocity; fastest 1 mile of wind for relevant exposure category.
- F. Thermal Movement: Provide metal-framed skylights that allow for thermal movements resulting from the following maximum change (range) in ambient temperatures by preventing buckling, sealant failure, and other detrimental effects.
1. Temperature Change (Range): 100 deg F.
- G. Air Infiltration: Provide metal-framed skylights with maximum air leakage of 0.06 cfm/sq. ft. of surface when tested according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft.
- H. Water Penetration: Provide metal-framed skylights that do not evidence water penetration when tested according to ASTM E 331 at a minimum differential static pressure of 20 percent of positive design wind load, but not less than 15 lbf/sq. ft.

- I. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 54 when tested according to AAMA 1503.

### 2.3 FRAMING MATERIALS

- A. Framing Members: Extruded aluminum alloy 6063-T6, ASTM B 221 with minimum effective thickness of 0.109 inches.
- B. Exterior Retaining Bars: Extruded aluminum alloy 6063-T6, ASTM B 221 with minimum effective thickness of 0.090 inches.
- C. Brackets and Reinforcements: Provide manufacturer's standard high-strength aluminum brackets and reinforcements. Provide nonstaining, nonferrous shims to install and align skylights.
- D. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing; compatible with adjacent materials.
- E. Exposed Flashing and Closures: Aluminum sheet alloy and temper of 1100-H14, thickness as require for proper performance.
  1. Minimum Thickness: 0.040 inch.
- F. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories; compatible with adjacent materials.
  1. Movement Joints: Provide slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.
  2. Aluminum-Retaining-Cap Fasteners and Framing Members Fasteners: ASTM A 193/A 193M, Series 300 stainless-steel screws; type as recommended by manufacturer.
  3. Connections to Supporting Structure: ASTM A 307, zinc-coated steel fasteners.
- G. Framing-System Sealants: One part low modulus silicone, compatible with components with which sealants come in contact.
- H. Bituminous Paint: Cold-applied asphalt mastic paint complying with SSPC-Paint 12, except containing no asbestos, and formulated for 30-mil thickness per coat.

### 2.4 GLAZING MATERIALS

- A. Insulating Glass: Decorative Glazing 1. Refer to Division 08 Section "Glazing" for glazing product.
- B. Glazing Gaskets: Manufacturer's standard pressure-glazing gaskets of elastomer type and hardness selected by skylight and gasket manufacturers to comply with requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.
- C. Spacers, Edge Blocks, and Setting Blocks: Manufacturer's standard permanent nonmigrating type of elastomer type and hardness selected to comply with requirements.
- D. Weatherseal Sealant: Neutral-curing silicone sealant recommended by skylight and sealant manufacturers for this use.

1. Sealant is capable of withstanding 50 percent movement in both extension and compression (total of 100 percent movement) when tested for adhesion and cohesion under maximum cyclic movement according to ASTM C 719.
2. Sealant complies with ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and, as applicable to substrates including other sealants with which it comes in contact, O.
3. Color: Black.

## 2.5 FABRICATION

- A. Where practical, fit and assemble metal-framed skylights in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Fabricate aluminum components before finishing.
- C. Fabricate aluminum components that, when assembled, have the following characteristics:
  1. Profiles that are sharp, straight, and free of defects or deformations.
  2. Accurately fitted joints with ends coped or mitered.
  3. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within skylight to exterior.
  4. Physical and thermal isolation of glazing from framing members.
  5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
- D. Fabricate aluminum sill closures with weep holes and for installation as continuous component.
- E. Reinforce aluminum components as required to receive fastener threads.
- F. Weld aluminum components in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- G. Factory Glazing: Locate and size extruded elastomeric setting blocks and spacers in accordance with the glazing manufacturer's recommendations. At no point shall the glazing come in contact with the skylight frame or fasteners.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

#### A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

- B. Metal Protection: Where aluminum will contact dissimilar materials, protect against galvanic action by painting contact surfaces with protective coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

- C. Install continuous aluminum sill closure with weatherproof expansion joints and locked and sealed or welded corners. Locate weep holes at rafters.

- D. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within skylight to exterior.

- E. Install components plumb and true in alignment with established lines and elevations.

- F. Field Glazing: Locate and size extruded elastomeric setting blocks and spacers in accordance with the glazing manufacturer's recommendations. At no point shall the glazing come in contact with the skylight frame or fasteners

- G. Erection Tolerances: Install metal-framed skylights to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet but no greater than 1/2 inch over total length.

### 3.3 CLEANING

- A. Clean skylights inside and outside, immediately after installation and after sealants have cured, according to manufacturer's written recommendations.

1. Remove temporary protective coverings and strippable coatings from prefinished metal surfaces. Remove labels and markings from all components.

- B. Remove excess sealant according to sealant manufacturer's written recommendations.

END OF SECTION 086300

## SECTION 08710 – FINISH HARDWARE

## PART 1 –GENERAL

## 1.01 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 01 General Requirements, apply to the work of this section.

## 1.02 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:
  - 1. Providing hardware for all doors, except doors provided with their own hardware.
  - 2. Providing lock cylinders for all work requiring cylinders.
  - 3. Providing the services of a qualified hardware consultant to prepare detailed schedules of hardware required for the project.

## 1.03 RELATED WORK

- A. Carefully examine all of the Contrast Documents for requirements which affect the work of this section. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:
  - 1. Section 081100 – Hollow Metal Doors and Frames; work requiring template coordination, metal astragals for fire-rated doors.
  - 2. Section 082100 – Wood Doors; work requiring template coordination, metal astragals for fire-rated doors.

## 1.04 INTENT

- A. A major intent of the work of this section is to provide hardware for every door in the project, except as indicated, so that each door functions correctly for its intended use. Provide only hardware that complies with applicable codes and requirements of authorities having jurisdiction including requirements for barrier-free accessibility.

## 1.05 QUALITY ASSURANCE

- A. Hardware supplier shall have in his employ one or more members of the Door and Hardware Institute to include at least one Certified Architectural Hardware Consultant in good standing, who shall be responsible for preparation of the Finish Hardware Schedule. This Consultant shall be acceptable to the Architect and is to ensure that the intent requirement of this specification is fulfilled, and certify that the work of this section meets or exceeds the requirements specified in this section and the requirements of authorities having jurisdiction.
- B. Hardware supplier shall warrant and guarantee, in writing, that hardware supplied is free of defective material and workmanship. Supplier shall further warrant and guarantee for a period of one year from Owner's Use and Occupancy that the hardware shall function in a satisfactory manner without binding, collapse, or dislodging of its parts, provide the installation is made to the manufacturer's recommendations.
- C. The hardware supplier shall repair or remedy, without charge, any defect of workmanship or material for which he is responsible hereunder.



## 1.06 SUBMITTALS

- A. Submit the following in accordance with SECTION 013300-SUBMITTALS:
1. Schedule: Submit to the Architect six (6) copies of the complete hardware schedule within the fourteen (14) days after receipt of contract award. Submit therewith complete catalog cuts and descriptive data of all products specifically scheduled therein. No materials shall be ordered or templates issued until the hardware schedule has been approved by the Architect. Form and detail of hardware schedule shall be in vertical format in conformance to the door and hardware industry standards. All hardware sets shall be clearly cross-referenced to the hardware set numbers listed in the specifications.
  2. Samples: If requested, submit to the Architect for approval, a complete line of samples as directed. Samples shall be plainly marked giving hardware number used in this specification, the manufacturer's numbers, types and sizes. The Architect will deliver approved samples to the project site to be stored. Samples will remain with the Architect until delivery of all hardware to the project is complete, after which time they will be turned over to the General Contractor for incorporation into the work.
  3. Keying System Submission: Before cylinders are ordered, submit a complete proposed keying system for approval. This should be done after a keying meeting has been held with the owner's representative.

## 1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of hardware shall be made to the project by the Hardware Supplier in accordance with the instructions of the General Contractor.
- B. The finish hardware shall be delivered to the jobsite and received there by the General Contractor. The General Contractor shall prepare a locked storage room with adequate shelving, for all hardware. The storage room shall be in a dry, secure area, and shall not include storage of other products by other trades.
- C. The General Contractor shall furnish the Hardware Supplier with receipts for all hardware and accessory items received, and shall send copies of these receipts to the Architect, if requested.

## 1.08 REGULATORY REQUIREMENTS

- A. Conform to all applicable codes. Provide all throws, projections, coatings, knurling, opening and closing forces, and other special functions required by State and Local Building Codes, and all applicable Handicap Code requirements.
- B. For fire rated openings, provide hardware complying with NFPA 80 and NFPA 101 without exception. Provide only hardware tested by UL for the type and size of door installed and fire resistance rating required.

## 1.09 SPECIAL REQUIREMENTS

- A. Hardware Supplier shall determine conditions and materials of all doors and frames for proper application of hardware.
- B. The Hardware Schedule shall list the actual product series numbers. Bidders are required to follow the manufacturers' catalog requirement for the actual size of door closers,

brackets and holders. All door opening sizes are as noted on the Door Schedule and all hardware shall be in strict accordance with requirements of height, width, and thickness.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Hinges	McKinney Stanley	Scranton, PA New Britain, CT
Locksets	Sargent	New Haven, CT
Exit Devices	Sargent Von Duprin	New Haven, CT Indianapolis, IN
Door Closers	Sargent LCN	New Haven, CT Princeton, IL
Door Stop	Glynn Johnson Ives Rockwood	Indianapolis, IN New Haven, CT Rockwood, PA
Push/Pulls	Rockwood Burns Ives	Rockwood, PA Erie, PA New Haven, CT
Protective Plates	Rockwood Burns Ives	Rockwood, PA Erie, PA New Haven, CT
Thresholds/ Weatherstripping/ Rain Drips/ Sound Seals	NGP Pemko Reese	Memphis, TN Memphis, TN Rosemount, MN
Silencers	Ives Glynn Johnson Rockwood	New Haven, CT Indianapolis, IN Rockwood, PA

2.02 MATERIALS AND QUALITY

- A. All hardware shall be of the best grade of solid metal entirely free from imperfections manufacturer and finish.
- B. Qualities, weights, and sizes given herein are the minimum that will be accepted. It is the responsibility of the Hardware Supplier to supply the specified size and weight of hardware and the proper function of hardware in each case and to provide UL approved hardware at all fire rated doors.
- C. Provide, as far as possible, locks of one lock manufacturer and hinges of one hinge manufacturer. Modifications to hardware that are necessary to conform to construction shown or specified shall be provided as required for the specified operation and functional features.

2.03 HARDWARE DESIGNATIONS

- A. All items of hardware are referenced by manufacturer's names and numbers. The manufacturer's names and numbers are used to define the function, design, and the quality of the material to be supplied.

Substitution of products other than those listed shall be submitted to the Architect at least ten (10) days PRIOR to the bid date. The Architect shall be the sole judge of any proposed substitution.

#### 2.04 TEMPLATES

- A. Hardware supplier shall immediately, but not later than three (3) days after approval of his Schedule by the Architect, furnish the General Contractor with complete template information necessary for the fabrication of doors, frames, etc. No templates shall be furnished prior to the approval of the hardware schedule.

#### 2.05 HARDWARE FOR LABELED FIRE DOORS, EXIT DEVICES AND SMOKE DOORS

- A. Hardware shall conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Labeling and listing by UL Building Materials Directory, for class of door being used will be accepted as evidence of conformance to these requirements. Install minimum latch throw as specified on label of individual doors. Provide hardware listed by UL except where heavier materials, larger sizes, or better grades are specified herein under paragraph entitled "Hardware Sets". In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may be submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements. Specific hardware requirements of door or frame manufacturers which exceed sized or weights of hardware herein listed shall be provided with no additional charge.

#### 2.06 KEYS AND KEYING

- A. The hardware supplier shall review the specific hardware functions with the Architect and owner at the time of the keying review, to assure the appropriateness of each of the hardware functions. Failure to make this review does not relieve the hardware supplier from providing the proper functions.
- B. Key System: All cylinders shall be Masterkeyed and Grandmaster Keys to the existing Sargent Signature removable core system.
1. Master keys, Grandmaster Keys: Furnish six (6) keys for each set, if required.
  2. Furnish three (3) change keys for each cylinder keyed differently; six (6) change keys for each set keyed alike, and in sets where only (2) cylinders are keyed alike, four (4) change keys will be required.
  3. All keying is to be done at the factory to avoid duplication of the new cylinders.
  4. Master Keys shall be sent to the Owner by registered mail, return receipt required.
  5. Supply a bitting list for all change keys and master keys to the Owner.
  6. All lock cylinders shall be set to Construction key for use by the Contractor during the construction period. Furnish ten (10) Construction keys and two (2) voiding the Construction key feature.

7. Cylinders and keys shall be Sargent Signature Series by Sargent Manufacturing, New Haven, CT.
8. Master key or grand master key cylinders and key in groups, unless otherwise specified. Factory masterkey with manufacturer retaining permanent keying records.
9. Provide six (6) masterkeys for each masterkey set. Provide three (3) change keys for each lock. Provide two (2) control keys for core removal. Stamp keys "DO NOT DUPLICATE".
10. Submit proposed keying schedule to Architect. If requested, meet with Owner and Architect to review schedule.
11. Provide high security removable core cylinders, with patented key control, for each lock with construction masterkeying. Permanent cores shall be installed upon completion of the project.
12. Cylinders shall meet the requirements of UL437.

#### 2.07 FASTENERS

- A. Manufacture hardware to conform to published templates, generally prepared for machine screw installation.
- B. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Furnish exposed screws to match the hardware finish, or, if exposed in surfaces of other work, to match the finish of such other work as closely as possible, except as otherwise indicated.
- C. Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard manufactured units of the type specified are available with concealed fasteners. Do not use thru-bolts unless specifically approved by the Architect.
- D. All hardware shall be installed only with fasteners supplied by manufacturers of specific products.

#### 2.08 PACKING AND MARKING

- A. All hardware shall have the required screws, bolts and fastenings necessary for proper installation and shall be wrapped in the same package as the hardware item for which it is intended and shall match finish of hardware with which to be used.
- B. Each package shall be clearly labeled indicating the portion of the work for which it is intended.

#### 2.09 ENVIRONMENTAL CONCERN FOR PACKING

- A. The hardware shipped to the jobsite is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping. If non-biodegradable packing such as plastic, plastic bags or large amounts of Styrofoam is utilized, then the Contractor will be responsible for the disposal of the non-biodegradable packing to a licensed or authorized collector for recycling of the non-degradable packing.

2.10 FINISH HARDWARE DESCRIPTION

A. Hardware items shall conform to respective specifications and standards and to requirements specified herein.

B. MATERIALS AND FINISH MATERIALS AND FINISHES SHALL BE:

- 1. Interior Butts: US26D (BHMA 652)
- 2. Exterior Geared Hinges US28 (BHMA 628)
- 3. Door Closers: Sprayed to match hardware finish.
- 4. Exit Devices: US26D (BHMA 626)
- 5. Kick, Push Plates: US32D (BHMA 630)
- 6. All other hardware shall be: US26D (BHMA 626), or as scheduled.

C. HINGES

1. Number of hinges per door, two hinges for doors up to and including five feet in height and an additional hinge for each two and one half feet or fraction thereof.

2. Hinges shall be as follows:

Exterior	McKinney Stanley	TA2314 4 1/2 x 4 1/2 NRP FBB191 4 1/2 x 4 1/2 NRP
Interior	McKinney Stanley	TA2714 4 1/2 x 4 1/2 FBB179 4 1/2 x 4 1/2
Elec	McKinney Stanley	TA2714-CC4 CEFBB179

D. DOOR CLOSERS:

- 1. Door closers shall have fully hydraulic, full rack and pinion action. Cylinder body shall be 1-1/2" in diameter, and double heat treated pinion shall be 11/16" in diameter.
- 2. Hydraulic fluid shall be of a type requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
- 3. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and hydraulic back-check.
- 4. All closers shall have solid forged steel main arms (and forged forearms for parallel arm closers).
- 5. Closer arms (and metal covers when specified) shall have a powder coating finish.
- 6. Provide drop, mounting plates, where required.
- 7. Do not locate closers on the side of doors facing corridors, passageways or similar type areas. Where it is necessary, due to certain conditions and approval of the Architect, to have closers in corridors, provide such closers with parallel or track type arms.

- 8. All door closers shall be adjusted by the installer in accordance with the manufacturer's templates and written instructions. Closers with parallel arms shall have back-check features adjusted prior to installation.
- 9. Closers shall conform to all applicable code requirements relative to setting closing speeds for closers and maximum pressure for operating interior and exterior doors.
- 10. Door closers meeting this specification are as follows:

	LCN	Sargent
Exterior	4111S-CUSH	281 – CPS
	4111S-H-CUSH	281 – CPSH
Interior	4011	281- 0
	4111	281 – P10
	4040SE	2407 Series
	4000T	281 – OT x spec. TEMP.
	4310ME-SF	2980
	4040SE-DE	2477

E. EXIT DEVICES:

- 1. Shall be Von Duprin or Sargent as follows:

Function	Von Duprin	Sargent
A	CD99NL-OP	16-8804
B	CD99EO	16-8810
C	99L	8804ET
D	99L-BE	8815ET
E	99EO-F	12-8810
F	99L-F	12-8813ET
G	99L-F-BE	12-8815ET
H	9927EO	8710
I	9927L	8713ET
J	9927L-BE	8715ET
K	CD9927EO x LBR	16-PP/PR8710
L	9927L x LBRPP/PR	8713ET
M	9927L-BE x LBRPP/PR	8715ET
N	9927EO-F	12-8710
O	9927L-F	12-8713ET
P	9927L-F-BE	12-8715ET
Q	9927EO-F x LBR12-PP/PR	8710
R	9927L-F x LBR	12-PP/PR8713ET
S	9927L-F-BE x LBR	12PP/PR8715ET
T	9927TP	8710 x 306
U	EL99L-F	56-12 8813 ETL
V	EL99NL-OP	56-8804
W	EL99L	56-8813-ETL
X	99L	8813 ETL

NOTE: Lever design shall match lock trim

- F. Where removable mullions are required for pairs of doors, provide a fire rated U.L. listed channel iron mullion. Fire rated U.L. listed mullions shall be provided for all pairs of doors requiring mullions whether the door carries a fire rating or not.

On pairs of doors where removable mullions are called for, the mullions shall be UL rated for both rated and non rated doors as follows:

Sargent - 12-980  
 Von Duprin - 9954

G. LOCKSETS, LATCH SETS:

- 1. Mortise type shall be heavy-duty ANSI A156.13, Series 1000, Grade 1 Operational, 2-3/4" backset, six pin cylinder with lever handles.

Manufacturer	Series	Lever Design
Schlage	L9000	06A
Sargent	8200	LNL
Best	35H	16H

- 2. Lock functions as indicated in the hardware schedule shall be as follows:

Function	Schlage	Sargent	Best
MA	80-LLL	06	7D-IS3

H. HEAVY DUTY LEVER HANDLE CYLINDRICAL LOCKS:

- 1. Locksets for this project shall be heavy duty cylindrical key in lever handle type locksets.
- 2. Locksets shall be 2 3/4" backset with 1/2" throw latchbolt, with deadlocking latch, and a cylindrical housing of steel with a zinc dichromate finish.
- 3. Locksets shall be fastened by thru bolts, thru the 3 1/2" diameter inside rose back plate into the threaded studs in the outside rose back plate. Thru bolts shall be placed in separate bolt holes, thru the door and outside the cylindrical case at 180° from each other.
- 4. The inside and outside rose scalps shall be 3 1/2" diameter wrought brass or bronze. When assembled, all thru bolts in the face of the door shall be concealed from view. The lever handles shall be solid cast in the same finish as the rose.
- 5. Cylinders for lever handle cylindrical locks shall be 6 pin tumbler, solid brass, with nickel silver keys. Two keys shall be supplied with each lock or cylinder. See "Keying Section 2.OIF" for masterkey information.
- 6. The 1/2" throw latchbolt shall be listed and approved for use by Underwriters Laboratories.
- 7. Strikes shall be curved lip ANSI A - 115.2 4 7/8" x 1 1/4" wrought brass or bronze.
- 8. The following locksets shall be considered acceptable for this project:  
 Sargent "10" Line LL Design

9. All locksets and cylinders for this project, shall be by Sargent and Co. to accommodate existing Sargent high security system.

10. The following is a list of lock functions as indicated under "hardware set":

<u>Function</u>	<u>Sargent</u>
A	04
B	05
C	15
D	37
E	65
F	16
G	38

I. DEADLOCKS:

<u>Function</u>	<u>Sargent</u>	<u>Schlage</u>
DA	4877	9463

J. ELECTRIC DOOR OPENER/CLOSER:

When indicated in the hardware sets provide electric door opener/closer model 4100 as manufactured by Horton.

K. REMOTE KEY SWITCH:

Provide key switch where indicated to be equal to model 7910-219 by LCN.

L. PUSH PLATES, DOOR PULLS, PUSH/PULL BARS:

1. Shall be as manufactured by Rockwood, Burns or Ives.

a. Push plates shall be 4" x 16" x .050 thickness unless otherwise listed in hardware sets.

Rockwood	70 Series
Burns	50 Series
Quality	40 Series

b. Door pulls shall be 1" x 10"

Type A

Rockwood	BF111
Burns	BF26C
Quality	BF163-10"

c. Flush Pulls

Where called for in the hardware sets provide Rockwood 94L or equal.

d. Push/Pull bars



Type A (Wide Stile Doors)

Rockwood	BF11147 x T1006 Mounting
Burns	BF26C x 442 x Sim. Mounting as Above
Quality	BF 482 x Sim. Mounting as Above

M. KICK PLATES, ARMOR PLATES, MOP PLATES:

1. Kick plates shall be 8 in. high. Armor plates shall be 34 in. high. Mop plates shall be 4 in. high. All plates shall be 2 in. less the width of door. Plates shall be .050 thickness, bevel 4 edges, screws shall be oval head counter-sunk.

N. STOPS

1. Shall be furnished at all doors. Wherever and opened door or any item of hardware thereon strikes a wall, at 90 degrees. Provide wall bumpers, unless otherwise indicated in hardware sets.
2. Where wall bumpers cannot be effectively used, a floor stop shall be furnished and installed.
3. Provide roller bumpers for each door where two doors interfere with each other in swinging.

Manufacturer	Wall Bumpers	Floor Stops	Roller Bumpers
Rockwood	409	440, 442	456
Ives	407 ½	436B, 438B	470 Series
Glynn Johnson	WB 50XT	FB13, FB14	RB-3

4. Where overhead stops are listed they shall be the surface mounted type as follows:

Manufacturer	Series
Glynn Johnson	GJ450
Sargent	1540
ABH	4400

O. THRESHOLDS, WEATHERSTIP, SEAL:

1. Thresholds shall be as detailed and furnished on all doors where shown on drawings. Thresholds shall be aluminum unless otherwise indicated. Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants".
2. Weatherstripping shall be furnished on all exterior doors unless otherwise indicated.

Product	Pemko	Reese	NGP
Threshold	as detailed		
Brush Seal	45062AP	970	A626A
Auto. Door Bottom	430CR	330	420
Door Sweep	345AV	353	101AV
Set Astragals	351C x 351CP	95 x 95P	140 x 140P

Astragal	357SP	183S	139SP
Rain Drip	346C	R210A	16A

P. ELECTRO MAG HOLDER:

1. Shall be model FM 998 by Rixson.

PART 3—EXECUTION

3.01. INSPECTION

1. It shall be the general contractors' responsibility to inspect all doors openings and doors to determine that each door and door frame has been properly prepared for the required hardware. If errors in dimensions or preparation are encountered, they are to be corrected by the responsible parties prior to the installation of hardware.

3.02. PREPARATION

1. All doors and frames, requiring field preparation for finish hardware, shall be carefully mortised, drilled for pilot holes, or tapped for machine screws for all items of finish hardware in accordance with the manufacturers' templates and instructions.

3.03. INSTALLATION/ADJUSTMENT/LOCATION

1. All materials shall be installed in a workmanlike manner following the manufacture's recommended instructions.
2. Exit Devices shall be carefully installed so as to permit friction free operation of crossbar, touch bar, lever. Latching mechanism shall also operate freely without friction or binding.
3. Door Closers shall be installed in accordance with the manufacturer's instructions. Each door closer shall be carefully installed, on each door, at the degree of opening indicated on the hardware schedule. Arm position shall be shown on the instruction sheets and required by the finish hardware schedule.
4. The adjustments for all door closers shall be the installer's responsibility and these adjustments shall be made at the time of installation of the door closer. The closing speed and the latching speed valves, shall be adjusted individually to provide a smooth, continuous closing action without slamming. The delayed action feature or back check valve shall also be adjusted so as to permit the correct delayed action cycle or hydraulic back check valve shall also be adjusted so as the opening cycle. All valves must be properly adjusted at the time of installation. Each door closer has adjustable spring power capable of being adjusted, in the field from size 2 thru 6. It shall be the installers' responsibility to adjust the spring power for each door closer in exact accordance with the spring power adjustment chart illustrated in the door closer installation sheet packed with each door closed.
5. Installation of all other hardware, including locksets, push-pull latches, overhead holders, door stops, plates and other items, shall be carefully coordinated with the hardware schedule and the manufacturer's instruction sheets.
6. Locations for finish hardware shall be in accordance with dimensions listed in the pamphlet "Recommended locations for Builders' Hardware" published by the Door and Hardware Institute.

## 3.04 FIELD QUALITY CONTROL

1. Upon completion of the installation of the finish hardware, it shall be the responsibility of the finish hardware supplier to visit the project and to examine the hardware for each door on which he has provided hardware and to verify that all hardware is in proper working order. Should he find items of hardware not operating problem he should make a report, in writing, to the general contractor, advising him of the problem and the measures required to correct the problem.

## 3.05 PROTECTION

1. All exposed portions of finish hardware shall be carefully protected, by use of cloth, adhesive backed paper or other materials, immediately after installation of the hardware item on the door. The finish shall remain protected until completion of the project. Prior to acceptance of the project by the Architect and owner, the general contractor shall remove the protective material exposing the finish hardware.

## 3.06 CLEANING

1. It shall be the responsibility of the general contractor to clean all items of finish hardware and to remove any remaining pieces of protective materials and labels.

## 3.07 INSTRUCTIONS AND TOOLS

1. It shall be the responsibility of the finish hardware supplier to provide installation and repair manuals and adjusting tools, wrenches, etc... for the following operating products.
  - a. Locksets (all types)
  - b. Exit Devices (all types)
  - c. Door Closers

## 3.08 HARDWARE SETS

1. Each Hardware Set listed below represents the complete hardware requirements for one opening. (Single Door or Pair of Doors). Furnish the quantities required for each set for the work.

ITEM 1

Door E101A

Pair to Have: Hinges, Exit Device (Function A) (Active), Cylinders, Exit Device (Function B) (Inactive), Offset Pulls, Closers with Mounting Plates, Removable Mullion

Remainder of Hardware by Aluminum Door Manufacturer

ITEM 2

Door E115A

Pair to Have: Hinges, Electric Hinge, Exit Device (Function V) (Active), Exit Device (Function B) (Inactive Leaf), Offset Pulls, Kick Plates, Removable Mullion, Weatherstrip, Door Bottoms, Threshold, Cylinders, Power Supply, Cylinder, Key Switch

ITEM 3

Doors E101B, 101D

Door to Have: Hinges, Electric Hinge, Exit Device (Function V), Offset Pull, Door Operator, Cylinder, Power Supply, Key Switch  
Remainder of Hardware by Aluminum Door Manufacturer

ITEM 4

Door E109A

Door to Have: Hinges, Lockset (Function G), Closer, Kick Plates, Weatherstrip, Door Bottom, Threshold, Floor Stop

ITEM 5

Door E108A

Pair to Have: Hinges, Exit Devices (Function B), Closers, Kick Plates, Removable Mullion, Weatherstrip, Door Bottoms, Threshold, Cylinder

ITEM 6

Doors E108B, E108C

Each Door to Have: Hinges, Exit Device (Function B), Closer, Kick Plate, Weatherstrip, Door Bottom, Threshold, Cylinder

ITEM 7

Door E110A

Pair to Have: Hinges, Lockset (Function A), Flush Bolts, Closers, Kick Plates, Weatherstrip, Door Bottoms, Threshold, Astragal, Weatherstrip

ITEM 8

Door E149A

Door to Have: Hinges, Exit Devices (Function C), Closer  
Remainder of Hardware by Aluminum Door Manufacturer

ITEM 9

Door E111A

Door to Have: Hinges, Exit Device (Function C), Closer, Kick Plate, Weatherstrip, Door Bottom, Threshold

ITEM 10

Doors E142A, E142B, E156A, E156B

Doors to Have: Hinges, Exit Device (Function A), Closer, Mounting Plate, Offset Pull, Cylinders  
Remainder of Hardware by Aluminum Door Manufacturer

ITEM 11

Door E224BA

Door to Have: Hinges, Lockset (Function A), Closer, Kick Plate, Weatherstrip, Door Bottom, Threshold

ITEM 12

Door 101C

Pair to Have: Hinges, Exit Device (Function A), Closers, Offset Pulls, Removable Mullion, Weatherstrip, Door Bottoms, Cylinders, Threshold

ITEM 13

Door 101D

Door to Have: Hinges, Electric Hinge, Exit Device (Function V), Closer, Kick Plate, Weatherstrip, Door Bottom, Threshold, Cylinder

ITEM 14

Door 109A

Door to Have: Hinges, Push Plate, Pull, Closer, Weatherstrip, Door Bottom, Threshold

ITEM 15

Door 111B

Door to Have: Hinges, Exit Device (Function F), Closer, Kick Plate, Stop, Cylinder

ITEM 16

Doors 103A, 103B

Each Pair to Have: Hinges, Exit Devices (Function F), Removable Mullion, Closers, Kick Plates, Smoke Seals, Cylinders

ITEM 17

Doors 108AA, 108BA

Each Pair to Have: Concealed Hinges, Lockset (Function MA), Flush Bolts, Closers, Kick Plates, Silencers, Flush Pulls

ITEM 18

Doors 110B, 150DA, 203AA, 214BA, 231A

Each Door to Have: Hinges, Lockset (Function A), Closer, Kick Plate, Smoke Seal

ITEM 19

Doors 108AB, 109AA, 107BA

Each Pair to Have: Hinges, Lockset (Function A), Flush Bolts

ITEM 20

Doors 112A, 113A

Each Door to Have: Hinges, Deadlock (Function DA), Closer, Push Plate, Pull, Kick Plate, Silencers, Stop

ITEM 21

Doors 104A, 135EA, 135DA, 135BA, 135GA, 138AA, 146AA, 151AA, 161AA, 150GA, 150CA, 150EA, 157AA, 158CA, 159AA, 204BA, 204EA, 204FA, 204HA, 204JA, 214CA, 214DA, 214FA, 214GA, 214JA, 214KA, 204CA

Each Door to Have: Hinges, Privacy Set (Function E), Stop, Silencers

ITEM 22

Doors 130A, 131AA

Each Door to Have: Hinges, Privacy Set (Function E), Closer, Kick Plate, Stop, Silencers

ITEM 23

Door 114A

Pair to Have: Hinges, Lockset (Function G), Flush Bolts, Removable Mullion, Closers, Kick Plates, Smoke Seal

ITEM 24

Doors 138A, 140B, 141B, 143B, 144B, 146B, 152B, 154B, 155B, 157B, 159B, 160B, 206B, 208B, 210B, 212B, 215B, 216B, 218B, 220B, 222B

Each Pair to Have: Hinges, Passage Set (Function C), Flush Bolts, Stop, Silencers

ITEM 25

Doors 104CA, 125A, 126A, 127A, 129A

Each Door to Have: Hinges, Lockset (Function B), Stop, Silencers

ITEM 26

Door 131A

Door to Have: Hinges, Lockset (Function B), Closer, Stop, Silencers

ITEM 27

Door 108CA

Door to Have: Hinges, Lockset (Function B), Sound Seal, Stop

ITEM 28

Door 116A

Door to Have: Hinges, Lockset (Function B), Closer, Kick Plate, Stop, Smoke Seal

ITEM 29

Doors, 107AA, 159BA, 224CA, 114AA, 160AA

Each Pair to Have: Hinges, Lockset (Function A), Stop, Silencers

ITEM 30

Doors 142C, 142D, 156C, 156D, 209A, 209B, 219A, 219B

Each Door to Have: Hinges, Exit Device (Function F), Closer, Kick Plate, Stop, Silencers

ITEM 31

Doors 135A, 150A, 204A, 214A, 118A

Each Pair to Have: Hinges, Push Plate, Pull, Closer, Kick Plate, Electro Mag Holders, Silencers

ITEM 32

Door 102G

Pair to Have: Hinges, Electric Hinge, Exit Device (Function W) (Active), Exit Device (Function X) (Inactive), Removable Mullion, Power Supply, Closers, Smoke Seal, Kick Plates

ITEM 33

Door 108B

Door to Have: Hinges, Exit Device (Function X), Closer, Kick Plate, Cylinder, Silencers

ITEM 34

Doors 107A, 117A, 121A, 119A, 122A, 122B, 121A, 120A, 121A, 123A, 137A, 138A, 139A, 140A, 141A, 143A, 144A, 145A, 146A, 147A, 147B, 148A, 162A, 163A, 151A, 150BA, 152A, 153A, 154A, 155A, 157A, 159A, 160A, 207A, 208A, 210A, 211A, 213A, 215A, 216A, 217A, 218A, 220A, 221A, 222A, 223A, 206A, 212A, 161A

Each Door to Have: Hinges, Lockset (Function G), Closer, Kick Plate, Sound Seal, Stop

ITEM 35

Doors 104A, 124A1

Each Door to Have: Hinges, Lockset (Function G), Stop, Silencers

ITEM 36

Doors 135CA, 135FA, 136A, 123AA, 128AA, 232A, 204A, 204DA, 205A, 224A, 224CA, 224BB, 224AA, 214EA, 214HA, 214LA

Each Door to Have: Hinges, Lockset (Function G), Closer, Kick Plate, Stop, Silencers

ITEM 37

Doors 158AA, 158BA, 121AA

Each Door to Have: Hinges, Latchset (Function C), Stop

ITEM 38

Doors 119AA, 119BA, 124A, 128A

Each Door to Have: Hinges, Lockset (Function D), Closer, Kick Plate, Stop, Silencers

ITEM 39

Doors 149B

Pair to Have: Hinges, Exit Devices (Function X), Closers, Removable Mullion, Sound Seal, Stops, Kick Plates, Cylinders

END OF SECTION 087100

## SECTION 088000 - GLAZING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Storefront framing.
4. Glazed entrances.
5. Interior borrowed lites.
6. One-way mirror glass.

- B. Related Sections:

1. Division 08 Section "Flush Wood Doors" for wood doors to be factory glazed.

## 1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

## 1.4 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Design glass, including comprehensive engineering analysis according to ICC's 2003 International Building Code by a qualified professional engineer, using the following design criteria:
  1. Design Wind Pressures: As indicated on Drawings.
  2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.



3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
  4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

#### 1.5 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. LEED Submittals:
1. Product Data for Credit EQ 4.1: For glazing sealants used inside of the weatherproofing system, including printed statement of VOC content.
- C. Glass Samples: For each type of the following products; 12 inches square.
1. Insulating glass.
  2. Wired glass.
  3. Fire-resistive glazing products.
  4. Decorative glazing.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- E. 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.
- F. Product Certificates: For glass and glazing products, from manufacturer.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulating glass, glazing sealants and glazing gaskets.
- H. Preconstruction adhesion and compatibility test report.
- I. Warranties: Sample of special warranties.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
- B. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

- D. Source Limitations for Glass: Obtain insulating glass from single source from single manufacturer for each glass type.
- E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- G. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- H. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F, and the fire-resistance rating in minutes.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

#### 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

#### 1.9 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass 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 on Insulating Glass:** Manufacturer's standard form in which 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.
- C. **Manufacturer's Special Warranty on Decorative Glass:** Manufacturer's standard form in which decorative-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 GLASS PRODUCTS, GENERAL

- A. **Thickness:** Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
1. **Minimum Glass Thickness for Exterior Lites:** Not less than 6.0 mm.
  2. **Thickness of Tinted Glass:** Provide same thickness for each tint color indicated throughout Project.
- B. **Strength:** Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. **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. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
  2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  3. **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.
  4. **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.
  5. **Visible Reflectance:** Center-of-glazing values, according to NFRC 300.

### 2.2 GLASS PRODUCTS

- A. **Float Glass:** ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. **Heat-Treated Float Glass:** ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
  2. For uncoated glass, comply with requirements for Condition A.
  3. For coated vision glass, comply with requirements for Condition C (other coated glass).
- C. Polished Wired Glass: ASTM C 1036, Type II, Class 1 (clear), Form 1, Quality-Q6, complying with ANSI Z97.1, Class C.

### 2.3 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, and complying with other requirements specified.
1. Sealing System: Dual seal, with silicone primary seal and butyl secondary seal.
  2. Spacer: Aluminum with mill or clear anodic finish.
  3. Desiccant: Molecular sieve or silica gel, or blend of both.
- B. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article.

### 2.4 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.
- B. Laminated Ceramic Glazing: Laminated glass made from 2 plies of clear, ceramic flat glass; 5/16-inch total nominal thickness; complying with testing requirements in 16 CFR 1201 for Category II materials.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); FireLite Plus.
    - b. Schott North America, Inc.; Laminated Pyran Crystal.
    - c. Vetrotech Saint-Gobain; SGG Keralite FR-L.

### 2.5 ONE-WAY MIRROR GLASS

- A. One-Way Reflective Mirror Glass: ASTM C1036, Type 1 transparent flat, Class 1 (clear), Quality q3 (Glazing Select).
1. Thickness: 6.0 mm (1/4 inch), tempered per ANSI Z97.1.

### 2.6 DECORATIVE GLAZING

- A. Standard Unit Composition: Panelite ClearShade™ panels are composed of monolithic glass facings and polycarbonate tubular honeycomb core. Units comply with ASTM 1036 (float glass,) ASTM 1048 (heat treated, tempered glass, ) SGCC (heat-treated glass) and the aesthetic and performance requirements specified by Panelite. Additionally, units are IGCC certified and CBA rated.
1. Inboard Lite: 3/16 inch thick clear tempered glass.

2. Interior: Dehydrated 5/8 inch thick airspace with clear Panelite tubular honeycomb core (1/4 inch cell size).
  3. Outboard Lite: 3/16 inch thick, clear tempered glass with Low-E coating.
- B. Overall Unit Thickness: 1 inch.
- C. Sealing System: Dual seal with primary and secondary sealants as follows:
1. Polyisobutylene and 2-part silicone.
- D. Spacer: Standard spacer material and construction as follows:
1. Clear anodized aluminum.
  2. Desiccant.
  3. Corner Construction: CNC bent, welded or plastic key.
- E. Colors:
1. Decorative Glazing 1: Clear IGU/TC4.
  2. Decorative Glazing 2: Golden Light IGU/TO4.
  3. Decorative Glazing 3: True Blue IGU/TB4.

## 2.7 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
1. Neoprene complying with ASTM C 864.
  2. EPDM complying with ASTM C 864.
  3. Silicone complying with ASTM C 1115.
  4. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, silicone, or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

## 2.8 GLAZING SEALANTS

- A. General:
1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.

4. 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; 890.
    - e. Sika Corporation, Construction Products Division; SikaSil-C990.
    - f. Tremco Incorporated; Spectrem 1.
- C. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

## 2.9 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.

## 2.10 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

## 2.11 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

## 2.12 MONOLITHIC-GLASS TYPES

- A. Glass Type GL-1: Clear laminated float glass.

1. Thickness: 6.0 mm.
2. Provide safety glazing labeling.

- B. Glass Type GL-2: Polished wired glass.

1. Thickness: 6.0 mm.

## 2.13 INSULATING-GLASS TYPES

- A. Glass Type GL-3: Low-e-coated, clear insulating glass for hollow metal doors.

1. Overall Unit Thickness: 5/8 inch.
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Float glass.
4. Interspace Content: Air.
5. Indoor Lite: Float glass.
6. Provide tempered glass and safety glazing labeling where required by code.

- B. Glass Type GL-4: Low-e-coated, clear insulating glass for aluminum entrances and storefronts.

1. Overall Unit Thickness: 1 inch.
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Float, tempered glass where required by code.
4. Interspace Content: Air.
5. Indoor Lite: Float, tempered glass where required by code.
6. Low-E Coating: Provide LoE2 coating.
7. Provide safety glazing labeling where required by code.
8. Basis-of-Design Product: LoE2-270 #2/Clear by Cardinal Glass.
9. Performance Values:
  - a. Visible Light Transmission: 70%.
  - b. Overall Window U: 0.32.
  - c. Overall Window SHGC: 0.29.

## 2.14 FIRE-PROTECTION-RATED GLAZING TYPES

- A. Glass Type GL-5: 45-minute, 60-minute, 90-minute fire-rated glazing; laminated ceramic glazing.

1. Provide safety glazing labeling.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  2. Presence and functioning of weep systems.
  3. Minimum required face and edge clearances.
  4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

#### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.



1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

#### 3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

#### 3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. 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.

### 3.6 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.

### 3.7 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

## SECTION 092216 - NON-STRUCTURAL METAL FRAMING

## 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 work of this Section, as well as Sections 054000 and 092900, will be provided as a Filed Sub Bid.
- B. This Section includes non-load-bearing steel framing members for the following applications:
  - 1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
  - 2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).
- C. Related Sections include the following:
  - 1. Division 05 Section "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor, soffit and ceiling joists.
  - 2. Division 07 Section "Thermal Insulation" for insulation installed with Z-shaped furring members.
  - 3. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for non-load-bearing metal shaft-wall framing, gypsum panels, and other components of shaft-wall assemblies.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: For all interior walls greater than 14'-0" in height, (primarily in Segment "A" around the Lobby, Vestibules, Platform, Cafeteria, Gym and Music Rooms) provide cold-formed metal framing (including studs and headers) capable of withstanding design loads within limits and under conditions indicated.
  - 1. Design Loads: Per Chapter 16 of the 2006 IBC and ASCE 7-05 for internal wind pressure but not less than 5 psf.
  - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
    - a. Wall Framing: Horizontal deflection of 1/360 of the wall height.
    - b. Wall Headers, Ceiling Joist Framing: Vertical deflection of 1/360 of the span.
  - 3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
  - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
    - a. Upward and downward movement of 3/4 inch.

- B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
  - 1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
  - 2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittal:
  - 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
  - 2. Credit MR 5.1: Product Data indicating location of material manufacturer for regionally manufactured materials.
    - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.
- C. Shop Drawings: Show complete layout of studs, jambs and headers for all walls on 1/4" = 1'-0" scale Wall Framing Elevations in their entirety, including but not limited to spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work. Shop drawing submittals without entire wall framing elevations are unacceptable and will not be reviewed. Architect's review includes but is not limited to suitability of the submittal for construction, inspection and as an Owner's record.
  - 1. For cold-formed metal framing indicated to comply with design loads, submit structural analysis calculations signed and sealed by the qualified professional engineer responsible for their preparation. The Engineer shall also sign and seal each shop drawing. Review of structural analysis calculations is for general conformance with requirements, completeness and assumed load path back to the primary structure. The responsibility for correctness rests solely with the design professional. The Architect reserves the authority to require resubmittal for observed deficiencies, or incompleteness. Calculations and Shop Drawings must be submitted together in the same submittal package for concurrent review.
  - 2. Nomenclature: Use Steel Stud Manufacturer Association (SSMA) four part identification code which identifies the size (both depth and flange width), style and material thickness of each member. Shop drawings without this nomenclature are unacceptable and will not be reviewed.

#### 1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, 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.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Steel Framing and Furring:
    - a. Dietrich Industries, Inc., UltraSteel™ Framing.
    - b. MarinoWare; Division of Ware Ind.
    - c. National Gypsum Company.
    - d. The Steel Network, Inc.
    - e. Unimast, Inc.
  - 2. Gypsum Board and Related Products:
    - a. G-P Gypsum Corp.
    - b. National Gypsum Company.
    - c. United States Gypsum Co.
  - 3. LEED Gypsum Board and Related Products:
    - a. G-P Gypsum Corp. (for regionally manufactured product)
    - b. United States Gypsum Co. (for recycled product)

### 2.2 NON-LOAD-BEARING STEEL FRAMING, GENERAL

- A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
  - 2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized or equivalent per ASTM A1003.

### 2.3 SUSPENSION SYSTEM COMPONENTS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
- C. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.

- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.
  - 1. Depth: 1-1/2 inches.
- E. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
  - 2. Steel Studs: ASTM C 645.
    - a. Minimum Base-Metal Thickness: As indicated on Drawings.
    - b. Depth: As indicated on Drawings.
  - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
    - a. Minimum Base Metal Thickness: 0.0179 inch.
  - 4. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
    - a. Configuration: Asymmetrical.
- F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
    - b. Chicago Metallic Corporation; 640-C Drywall Furring System.
    - c. USG Corporation; Drywall Suspension System.

## 2.4 STEEL FRAMING FOR FRAMED ASSEMBLIES

- A. Steel Studs and Runners: ASTM C 645.
  - 1. Minimum Base-Metal Thickness: 0.0179 inch.
  - 2. Depth: As indicated on Drawings.
- B. Slip-Type Head Joints: Where indicated, provide one of the following:
  - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
  - 2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
  - 3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
    - a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

- b. Products: Subject to compliance with requirements, provide one of the following:
  - 1) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
  - 2) Superior Metal Trim; Superior Flex Track System (SFT).
- C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fire Trak Corp.; Fire Trak.
    - b. Metal-Lite, Inc.; The System.
    - c. The Steel Network, Inc.; VertiClip SLD or VertiTrack VTD.
    - d. Dietrich: SLP-TRK Slotted Track.
- D. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges.
  - 1. Depth: 1-1/2 inches.
  - 2. Clip Angle: 1-1/2 by 1-1/2 inch, 0.068-inch- thick, galvanized steel or BridgeClip by The Steel Network, Inc.
- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  - 1. Minimum Base Metal Thickness: 0.0179 inch.
  - 2. Depth: As indicated on Drawings.
- F. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
  - 1. Configuration: Asymmetrical.
- G. Cold-Rolled Furring Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges.
  - 1. Depth: 3/4 inch.
  - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch.
  - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.
- H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

## 2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

## 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
  - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

## 3.4 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members,



install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

- a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
  3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  5. Do not attach hangers to steel roof deck.
  6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

### 3.5 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
  1. Space studs as follows:
    - a. Single-Layer Construction: 16 inches o.c., unless otherwise indicated.
    - b. Multilayer Construction: 16 inches o.c., unless otherwise indicated.
    - c. Cementitious Backer Units: 16 inches o.c., unless otherwise indicated.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
  1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two 0.312 inch (0.79 mm) (20 gage) studs at each jamb, unless otherwise indicated.

- b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
  - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
- 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
  - 6. Curved Partitions:
    - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches o.c.
- D. Direct Furring:
- 1. Screw to wood framing.
  - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- E. Z-Furring Members:
- 1. Erect insulation (specified in Division 07 Section "Thermal Insulation") vertically and hold in place with Z-furring members spaced 24 inches o.c.
  - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
  - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

## SECTION 092900 - GYPSUM BOARD

## 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 work of this section, as well as Sections 054000 and 092216, will be provided as a Filed Sub Bid.
- B. This Section includes the following:
  - 1. Exterior gypsum sheathing.
  - 2. Interior gypsum board.
  - 3. Tile backing panels.
  - 4. Sound attenuation blankets.
- C. Related Sections include the following:
  - 1. Division 05 Section "Cold-Formed Metal Framing" for load-bearing steel framing that supports gypsum board.
  - 2. Division 06 Section "Rough Carpentry" for wood framing and furring that supports gypsum board.
  - 3. Division 09 Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board.
  - 4. Division 09 painting Sections for primers applied to gypsum board surfaces.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For the following products:
  - 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.
- C. LEED Submittals:
  - 1. Credit MR 5.1: Product Data indicating location of material manufacturer for regionally manufactured materials.
    - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.

#### 1.4 QUALITY ASSURANCE

- 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.

#### 1.5 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

### PART 2 - PRODUCTS

#### 2.1 PANELS, GENERAL

- A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- B. Provide product that is manufactured within 500 miles of project site.

#### 2.2 EXTERIOR GYPSUM SHEATHING

- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. GlasRoc Sheathing; CertainTeed (BPB America, Inc.)
    - b. Dens-Glass Gold; Georgia-Pacific Corporation.
    - c. Fiberock Brand Sheathing with Aqua Tough; United States Gypsum Co.
  - 2. Type and Thickness: Type X, 5/8 inch thick.

3. Size: 48 by 96 inches minimum.

## 2.3 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. USG Corporation, Newington, NH plant.
- B. Type X:
  1. Thickness: 5/8 inch.
  2. Long Edges: Tapered.
- C. Abuse-Resistant Type: Manufactured to produce greater resistance to surface indentation, through-penetration (impact resistance), and abrasion than standard, regular-type and Type X gypsum board.
  1. Core: 5/8 inch, Type X.
  2. Long Edges: Tapered.
  3. Products: Subject to compliance with requirements, provide one of the following:
    - a. National Gypsum Company; Gold Bond Hi-Abuse Wallboard.
    - b. United States Gypsum Co.; SHEETROCK Brand Abuse-Resistant Gypsum Panels.
- D. High-Impact Type: Manufactured with Type X core, plastic film laminated to back side for greater resistance to through-penetration (impact resistance).
  1. Core: 5/8 inch thick.
  2. Plastic-Film Thickness: 0.010 inch.
  3. Products: Subject to compliance with requirements, provide one of the following:
    - a. National Gypsum Company; Hi-Impact Brand Fire-Shield Gypsum Wallboard, Hi-Impact 1000.
    - b. United States Gypsum Co.; Fiberock Gypsum Fiber Panels Type AR.
- E. Moisture- and Mold-Resistant Type: Complying with ASTM C1177/C 1177M, moisture- and mold-resistant core and surfaces.
  1. Core: 5/8 inch, Type X.
  2. Long Edges: Tapered.
  3. Basis of design Product: "DensArmor Plus" as manufactured by G-P Gypsum.

## 2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9.
  1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Custom Building Products; Wonderboard.

- b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
  - c. USG Corporation; DUROCK Cement Board.
2. Thickness: 1/2 inch.

## 2.5 TRIM ACCESSORIES

### A. Interior Trim: ASTM C 1047.

- 1. Material:
  - a. Galvanized or aluminum-coated steel sheet or rolled zinc.
  - b. Plastic where abutting exterior metal doors and windows.
  - c.
- 2. Shapes:
  - a. Cornerbead.
  - b. Bullnose bead.
  - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - d. L-Bead: L-shaped; exposed long flange receives joint compound.
  - e. Tear Away L Bead: L-shaped; exposed long flange receives joint compound with 5/16 inch wide protective masking leg that can tear away leaving a clean joint.
  - f. Expansion (control) joint.
  - g. Curved-Edge Cornerbead: With notched or flexible flanges.

## 2.6 JOINT TREATMENT MATERIALS

### A. General: Comply with ASTM C 475/C 475M.

### B. Joint Tape:

- 1. Interior Gypsum Wallboard: Paper.
- 2. Mold-Resistant Gypsum Wallboard: 10-by-10 glass mesh.
- 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 Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

- 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
- 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.
  - a. Use setting-type taping with mold-resistant gypsum wallboard.
- 3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
- 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
- 5. Skim Coat: Not required.

### D. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by backer unit manufacturer.

## 2.7 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing Board: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated, and complying with requirements for elastomeric sealants specified in Division 07 Section "Joint Sealants."

1. Available Product: 895 Silicone building Sealant by Pecora Corporation.

- B. Sheathing Tape for Glass-Mat Gypsum Sheathing Board: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.

## 2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

- C. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch thick, attach sheathing to comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch thick, attach sheathing to comply with ASTM C 954.

- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

- E. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."

1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- F. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

- G. Firestopping: As specified in Division 07 Section "Penetration Firestopping."

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.



- J. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

### 3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
  - 1. Fasten gypsum sheathing to wood framing with screws.
  - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
  - 3. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
  - 4. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.
- C. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
  - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

### 3.4 SHEATHING JOINT-AND-PENETRATION TREATMENT

- A. Seal sheathing joints according to sheathing manufacturer's written instructions.
  - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient quantity 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 board 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. Apply sheathing tape to joints between foam-plastic sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

### 3.5 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Type X: Vertical and horizontal surfaces, unless otherwise indicated.
  - 2. Flexible Type: Apply in double layer at curved assemblies.
  - 3. Moisture- and Mold-Resistant Type: At the following locations:
    - a. Kitchen.
    - b. Locker rooms.
    - c. Toilets and bathrooms.
    - d. Custodial rooms.
- B. Single-Layer Application:
  - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.

2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
  - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
  - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

### 3.6 APPLYING TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at showers, tubs, and where indicated.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

### 3.7 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints where shown on the drawings or according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
  1. Cornerbead: Use at outside corners.
  2. LC-Bead: Use at exposed panel edges.
  3. L-Bead: Use where indicated.
  4. Tear Away L Bead: Use where gypsum board butts into concrete masonry units.
  5. Curved-Edge Cornerbead: Use at curved openings.

### 3.8 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. 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 other Division 09 Sections.
  - 5. Level 5: Not required.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

### 3.9 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
  - 1. Complete the following in areas to receive gypsum board ceilings:
    - a. Installation, insulation, and leak and pressure testing of water piping systems.
    - b. Installation of air-duct systems.
    - c. Installation of air devices.
    - d. Installation of mechanical system control-air tubing.
    - e. Installation of ceiling support framing.
    - f. Installation of Penetration Firestopping.

### 3.10 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

## SECTION 093000 - TILING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:

1. Ceramic tile.
2. Waterproof membrane.
3. Crack isolation membrane.
4. Tile backing panels.
5. Metal edge strips.

- B. Related Sections:

1. Division 09 Section "Gypsum Board" for glass-mat, water-resistant backer board.

## 1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittal:
  1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.

2. Credit MR 5.1: Product Data indicating location of material manufacturer for regionally manufactured materials.
    - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.
  3. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.
- C. Qualification Data: For qualified Installer.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of each type from one source or producer.
1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
1. Waterproof membrane.
  2. Crack isolation membrane.
  3. Joint sealants.
  4. Cementitious backer units.
  5. Metal edge strips.
- D. Preinstallation Conference: Conduct conference at Project site.
1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

#### 1.6 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 requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

## 1.8 EXTRA MATERIALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
  - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

## PART 2 - PRODUCTS

### 2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 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.

### 2.2 TILE PRODUCTS

- A. Tile Type CT1: Unglazed paver tile.
  - 1. Manufacturer: Subject to compliance with requirements, provide product by the following:
    - a. Daltile; Division of Dal-Tile International Inc.; Fabrique.
  - 2. Composition: Porcelain.
  - 3. Face Size: 11-13/16 by 11-13/16 inches.
  - 4. Thickness: 3/8 inch.
  - 5. Face: Plain with square edges.
  - 6. Tile Color and Pattern: Soliel Linen P687.
  - 7. Grout Color: As selected by Architect from manufacturer's full range.
  - 8. Install in quarter turned pattern.
- B. Tile Type CT2: Unglazed square-edged quarry tile.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Daltile; Division of Dal-Tile International Inc.; Quarry Tile.
  2. Face Size: 6 by 6 inches.
  3. Thickness: 1/2 inch.
  4. Wearing Surface: Abrasive aggregate embedded in surface.
  5. Tile Color and Pattern: Bronze OQ62.
  6. Grout Color: As selected by Architect from manufacturer's full range.
  7. 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: Coved with surface bullnose top edge, face size 5 by 6 inches.
- C. Tile Type CT3: Glazed wall tile.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Royal Mosa, Global Collection.
  2. Module Size: 6 by 6 inches.
  3. Thickness: 0.32 inch.
  4. Face: Plain with modified square edges.
  5. Grout Color: As selected by Architect from manufacturer's full range.
  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. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size 6 by 6 inches.
    - b. External Corners for Thin-Set Mortar Installations: Surface bullnose, same size as adjoining flat tile.
    - c. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.
  7. Tile Color and Pattern:
    - a. CT3a: 15130 Blue.
    - b. CT3b: 15060 Gold.
    - c. CT3c: 15090 Green.
    - d. CT3d: 15030 Beige.
- D. Tile Type CT4: Factory-mounted unglazed ceramic floor tile.
1. Manufacturer: Subject to compliance with requirements, provide products by the following:
    - a. Royal Mosa, Global Collection.
  2. Composition: Porcelain.
  3. Module Size: 6 by 6 inches.
  4. Thickness: 0.32 inch.
  5. Face: Plain with modified square edges.

6. Surface: Smooth, without abrasive admixture.
  7. Grout Color: As selected by Architect from manufacturer's full range.
  8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining floor tile. Provide shapes as follows, selected from manufacturer's standard shapes:
    - a. Base Cove: Cove, module size 3 by 6 inch.
    - b. External Corners for Thin-Set Mortar Installations: Surface bullnose.
    - c. Internal Corners: Cove.
  9. Tile Color and Pattern:
    - a. CT4a: 75830 Blue.
    - b. CT4b: 75760 Gold.
    - c. CT4c: 75790 Green.
    - d. CT4d: 75730 Beige.
- E. Tile Type CT5: Glazed wall tile.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crossville, Inc.
  2. Module Size:
    - a. CT5a: 12 by 12 inches.
    - b. CT5b: 6 by 12 inches.
  3. Thickness: 3/8 inch.
  4. Face: Plain with manufacturer's standard edges.
  5. Grout Color: As selected by Architect from manufacturer's full range.
  6. Tile Color:
    - a. CT5a: A1101 Sandbox.
    - b. CT5b: A1101 Sandbox.
- F. Tile Type CT6: Decorative glass wall tile.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Oceanside Glasstile.
  2. Module Size: 5 by 5 inches.
  3. Thickness: 3/8 inch.
  4. Face: Pattern of design indicated with manufacturer's standard edges.
  5. Grout Color: As selected by Architect from manufacturer's full range.
  6. Tile Color and Pattern:
    - a. CT6a: Color, Spruce Irid 036; pattern Koi..
    - b. CT6b: Color, Henna Irid 010; pattern Tararn.
    - c. CT6c: Color, Equator Irid 037; pattern Willow.
    - d. CT6d: Color, Fleet Blue Irid 027; pattern Pagoda.



G. Tile Type CT7: Decorative glass wall tile.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Oceanside Glasstile.
2. Module Size: 2-1/2 by 2-1/2 inches.
3. Thickness: 3/8 inch.
4. Face: Pattern of design indicated with manufacturer's standard edges.
5. Grout Color: As selected by Architect from manufacturer's full range.
6. Tile Color and Pattern:
  - a. CT7a: Color, Clear Irid 000; pattern Koi..
  - b. CT7b: Color, Truffle Irid 052; pattern Taram.
  - c. CT7c: Color, Cane Irid 006; pattern Willow.
  - d. CT7d: Color, Tahoe Irid 028; pattern Pagoda.

2.3 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, in maximum lengths available to minimize end-to-end butt joints.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. C-Cure; C-Cure Board 990.
    - b. Custom Building Products; Wonderboard.
    - c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
    - d. USG Corporation; DUROCK Cement Board.
  2. Thickness: 1/2 inch.

2.4 WATERPROOF AND CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and ANSI A118.12, 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 liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane. (2.39 g/L)
    - b. MAPEI Corporation; Mapelastc HPG with MAPEI Fiberglass Mesh. (31 g/L)

2.5 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Bonsal American; an Oldcastle company.
  - b. Bostik, Inc.
  - c. C-Cure.
  - d. Custom Building Products.
  - e. Laticrete International, Inc.
  - f. MAPEI Corporation.
2. Provide prepackaged, dry-mortar mix combined with acrylic resin liquid-latex additive at Project site.
  3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

## 2.6 GROUT MATERIALS

### A. Polymer-Modified Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bonsal American; an Oldcastle company.
  - b. Bostik, Inc.
  - c. C-Cure.
  - d. Custom Building Products.
  - e. Laticrete International, Inc.
  - f. MAPEI Corporation.
2. Polymer Type: Acrylic resin in liquid-latex form for addition to prepackaged dry-grout mix.

## 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 40 CFR 59, Subpart D (EPA Method 24).
  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.
- C. Products: Available products include the following:
  1. Keracaulk™ S by Mapei
  2. CeramaSeal by Bostik Findley

## 2.8 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.

1. Provide Schluter, in profiles indicated, or approved substitute.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- D. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Bonsal American; an Oldcastle company; Grout Sealer.
    - b. Bostik, Inc.; CeramaSeal Grout & Tile Sealer.
    - c. C-Cure; Penetrating Sealer 978.
    - d. Custom Building Products; Grout and Tile Sealer.
    - e. MAPEI Corporation; KER 004, Keraseal Penetrating Sealer for Unglazed Grout and Tile.

## 2.9 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
  1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  2. 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.
  3. 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.
  4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

### 3.3 TILE BACKING PANEL INSTALLATION

- A. Install cementitious backer units and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

### 3.4 TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
- B. 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.
- C. 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.
- D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
  - 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
- E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
  - 1. Unglazed Paver Tile: 1/16 inch.
  - 2. Ceramic floor tile: 1/16 inch.
  - 3. Quarry Tile: 1/4 inch.
  - 4. Glazed Wall Tile: 1/16 inch.
- F. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

- G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
  - 1. Where joints occur in concrete substrates, locate joints in tile surfaces as close as possible to directly above them.
- H. Metal Edge Strips: Install at locations indicated.
- I. Grout Sealer: Apply grout sealer to grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

### 3.5 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

### 3.6 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

### 3.7 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
  - 1. Remove latex-portland cement grout residue from tile as soon as possible.
  - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
  - 3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

## 3.8 INTERIOR TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor (slab-on-grade):
1. Tile Installation F113: Thin-set mortar; TCA F113.
    - a. Tile Type: Ceramic floor tile or quarry tile.
    - b. Thin-Set Mortar: Latex- portland cement mortar.
    - c. Ceramic tile grout: Polymer-modified unsanded grout.
    - d. Quarry tile grout: Polymer-modified sanded grout.
  2. Tile Installation F122: Thin-set mortar on waterproof membrane (elevated concrete slabs); TCA F122.
    - a. Tile Type: Ceramic floor tile.
    - b. Thin-Set Mortar: Latex- portland cement mortar.
    - c. Grout: Polymer-modified unsanded grout.
  3. Tile Installation F125A: Thin-set mortar on crack isolation membrane; TCA F125A.
    - a. Tile Type: Paver tile at Lobby and Cafeteria.
    - b. Thin-Set Mortar: Latex- portland cement mortar.
    - c. Grout: Polymer-modified unsanded grout.
- B. Interior Wall Installations, Metal Studs or Furring:
1. Tile Installation W243: Thin-set mortar on gypsum board; TCA W243.
    - a. Tile Type: Glazed and Decorative glass for corridor wainscot CT5, CT6, and CT7.
    - b. Thin-Set Mortar: Latex- portland cement mortar.
    - c. Grout: Polymer-modified unsanded grout.
  2. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA W244.
    - a. Tile Type: Glazed wall tile.
    - b. Thin-Set Mortar: Latex- portland cement mortar.
    - c. Grout: Polymer-modified unsanded grout.
- C. Shower Receptor and Wall Installations, Metal Studs or Furring:
1. Tile Installation B415: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA B415.
    - a. Tile Type: Glazed wall tile.
    - b. Thin-Set Mortar: Latex- portland cement mortar.
    - c. Grout: Polymer-modified unsanded grout.

END OF SECTION 093000

## SECTION 095113 - ACOUSTICAL PANEL CEILINGS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

## 1.3 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Maintenance Data: For finishes to include in maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
  - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
    - a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.

- b. Identify materials with appropriate markings of applicable testing and inspecting agency.
2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
  - a. Smoke-Developed Index: 450 or less.
- D. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
  1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
  1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

#### 1.8 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

#### 1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
  2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
  3. Hold-Down and Impact Clips: Equal to 2.0 percent of quantity installed.



## PART 2 - PRODUCTS

## 2.1 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
  - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
  - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

## 2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING (APC-1)

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Armstrong School Zone Fine Fissured High Acoustics, No. 1713.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
  - 1. Type III, mineral base with painted finish; Form 1 or 2, water felted.
  - 2. Pattern: C (perforated, small holes and E (lightly textured).
- C. Color: White.
- D. Light Reflectance Coefficient: Not less than LR 0.81.
- E. Noise Reduction Coefficient: NRC 0.70.
- F. Ceiling Attenuation Class: Not less than CAC 35.
- G. Edge Detail: Square.
- H. Thickness: 3/4 inch.
- I. Modular Size: 24 by 24 inches.
- J. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based.

## 2.3 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING (APC-2)

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Armstrong World Industries, Inc.; High Durability Fine Fissured No. 465.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
  - 1. Type and Form: Type III, mineral base with painted finish; Form 1, nodular or 2, water felted.
  - 2. Pattern: CE (perforated, small holes and lightly textured) and I (embossed).
- C. Color: White.
- D. LR: Not less than 0.80.
- E. NRC: Not less than 0.55.
- F. CAC: Not less than 35.
- G. Edge/Joint Detail: Square.
- H. Thickness: 5/8 inch.
- I. Modular Size: 24 by 24 inches.
- J. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based.

## 2.4 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING (APC-3)

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Armstrong Ceramaguard No. 605.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
  - 1. Type and Form: Type XX, other types; described as high-density, ceramic-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.
  - 2. Pattern: CD (perforated, small holes and fissured). G (smooth).
- C. Color: White.
- D. LR: Not less than 0.80.
- E. NRC: Not less than 0.55.
- F. CAC: Not less than 40.
- G. Edge/Joint Detail: Square.
- H. Thickness: 5/8 inch.
- I. Modular Size: 24 by 48 inches.

## 2.5 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
  - 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
  - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  - 2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.
- E. Hanger Rods and Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.
- G. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.
- H. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

## 2.6 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILINGS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Prelude 15/16" Exposed Tee System; Armstrong World Industries, Inc.
  - 2. S11 System; Celotex Corporation.
  - 3. DX 24 System; USG Interiors, Inc.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished 15/16-inch-wide metal caps on flanges.
  - 1. Structural Classification: Intermediate-duty system.
  - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
  - 3. Face Design: Flat, flush.
  - 4. Cap Material: Steelcold-rolled sheet.
  - 5. Cap Finish: Painted white.

## 2.7 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
  2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
  3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- B. Perimeter Trim Channel: Provide Trim Channel: (4") wide face with 3/4" horizontal legs, straight or curved sections with special bosses formed for attachment to the tee-bar connection clip or hanging clip; commercial quality, extruded aluminum, factory-finished in factory-applied baked polyester paint to match grid color.
1. Splice Plate: Galvanized steel finish; formed to fit into special bosses and locked in place with factory-installed screws.
  2. Tee-Bar Connection Clip: Commercial quality aluminum finish to match trim channel formed to fit into special bosses and locked in place by factory-installed screws and attached to suspension system members.
  3. Hanging Clip: Commercial quality aluminum finish to match trim channel formed to lock into special bosses and attach to suspension system members.
  4. Available Products: Axiom Classic Trim by Armstrong.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

### 3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

- B. Suspend ceiling hangers from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  9. Do not attach hangers to steel deck tabs.
  10. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  11. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
  2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
5. Install hold-down clips in areas within 10 feet of exterior doors.

#### 3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

## SECTION 096513 - RESILIENT BASE AND ACCESSORIES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

## A. Section Includes:

1. Resilient base.
2. Resilient stair accessories.
3. Resilient molding accessories.

## B. Related Sections:

1. Division 09 Section "Resilient Sheet Flooring" for resilient sheet floor coverings.
2. Division 09 Section "Resilient Tile Flooring" for resilient floor tile.
3. Division 09 Section "Resilient Athletic Flooring" for resilient floor coverings for use in athletic-activity or support areas.

## 1.3 SUBMITTALS

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

## B. LEED Submittals:

1. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content
  - a. Include statement indicating costs for each product having recycled content.
2. Credit MR 6.0: Product Data for rapidly renewable materials.
  - a. Include statement indicating costs for each rapidly renewable material.
3. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.

- C. Product Schedule: For resilient products. Use same designations indicated on Drawings.

## 1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

## 1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

## 1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

## PART 2 - PRODUCTS

## 2.1 RESILIENT BASE (WB1)

- A. Resilient Base:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Roppe Corporation, USA.
- B. Resilient Base Standard: ASTM F 1861.
  - 1. Material Requirement: Type TP (rubber, thermoplastic).
  - 2. Manufacturing Method: Group I (solid, homogeneous).
  - 3. Style: Cove (base with toe).
- C. Minimum Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.



- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Finish: Satin.
- I. Colors and Patterns: 625 Bronze.

## 2.2 RESILIENT BASE (WB2)

### A. Resilient Base:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Johnsonite; Inflection™ (MW-XX-G).

### B. Resilient Base Standard: ASTM F 1861.

- 1. Material Requirement: Type TP (rubber, thermoplastic).
- 2. Manufacturing Method: Group I (solid, homogeneous).
- 3. Style: Designer as indicated by product type.

### C. Minimum Thickness: 0.375 inch.

### D. Height: 5-1/4 inches.

### E. Lengths: 8 foot.

### F. Outside Corners: Job formed.

### G. Inside Corners: Job formed.

### H. Finish: Satin.

### I. Colors and Patterns: As selected by Architect from full range of industry colors.

## 2.3 RESILIENT BASE (WB3)

### A. Resilient Base:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved substitute.
  - a. Johnsonite Vent Cove Wall Base.

### B. Resilient Base Standard: ASTM F 1861.

- 1. Material Requirement: Type TP (rubber, thermoplastic).
- 2. Manufacturing Method: Group I (solid, homogeneous).
- 3. Style: Designer as indicated by product type.

### C. Minimum Thickness: 0.375 inch.

- D. Size: 4 inches high by 3 inches wide toe.
- E. Lengths: 4 foot.
- F. Outside Corners: Factory formed.
- G. Inside Corners: Job formed.
- H. Finish: Satin.
- I. Colors and Patterns: As selected by Architect from full range of industry colors.

#### 2.4 RESILIENT STAIR ACCESSORIES (RS1)

- A. Resilient Stair Treads:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Roppe: Fiesta with Relief Cut and nosing strip.
- B. Resilient Stair Treads Standard: ASTM F 2169.
  - 1. Material Requirement: Type TS (rubber, vulcanized thermoset).
  - 2. Surface Design:
    - a. Class 2, Pattern: Slate Textured design.
  - 3. Manufacturing Method: Group 1, tread with embedded abrasive strips.
  - 4. Provide abrasive strips at top and bottom treads only.
- C. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
- D. Nosing Height: 1-1/2 inches.
- E. Thickness: 1/4 inch and tapered to back edge.
- F. Size: Lengths and depths to fit each stair tread in one piece or, for treads exceeding maximum lengths manufactured, in equal-length units.
- G. Risers: Smooth, flat, coved-toe, 7 inches high by length matching treads integral with tread unit; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
  - 1. Thickness: 0.125 inch.
- H. Colors and Patterns: 401 Camello.

#### 2.5 RESILIENT MOLDING ACCESSORY

- A. Resilient Molding Accessory:
  - 1. Manufacturer: Subject to compliance with requirements, provide products by the following:

- a. Roppe.
- B. Material: Vinyl.
- C. Profile and Dimensions:
  - 1. Transition Strip between Resilient Tile and Carpet: No. 50 Tile/ Carpet Joiner by Roppe.
  - 2. Transition Strip between Sheet Flooring and Resilient Tile: No. 59 Reducers Strip by Roppe.
  - 3. Reducer Strip between Concrete and Resilient Tile: No. 45 Reducer Strip by Roppe.
  - 4. Reducer Strip between Concrete and Carpet: No. 38 Glue-Down Carpet by Roppe.
- D. Colors and Patterns: Match adjacent wall base.

## 2.6 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
  - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Cove Base Adhesives: Not more than 50 g/L.
    - b. Rubber Floor Adhesives: Not more than 60 g/L.
- C. Epoxy Adhesives: Two-part epoxy compound recommended by resilient tread manufacturer to adhere rubber treads and risers to substrates.
  - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Rubber Floor Adhesives: 60 g/L.
- D. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.
  - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Rubber Floor Adhesives: 60 g/L.
- E. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
- F. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are same temperature as the space where they are to be installed.
  - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

## 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.

- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible.

### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
  - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
  - 2. Tightly adhere to substrates throughout length of each piece.
  - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
  - 4. Install treads with abrasive strips only in the top 2 and bottom 2 treads at each stair. All other treads to be provided without abrasive strips.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

### 3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products until Substantial Completion.

END OF SECTION 096513

## SECTION 096516 - RESILIENT SHEET FLOORING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:

- 1. Linoleum sheet floor covering.

- B. Related Sections:

- 1. Division 06 Section "Interior Architectural Woodwork" for linoleum countertops not part of the work of this section.
  - 2. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.
  - 3. Division 09 Section "Resilient Tile Flooring" for resilient floor tile.
  - 4. Division 09 Section "Resilient Athletic Flooring" for resilient floor coverings for use in athletic-activity or support areas.

## 1.3 SUBMITTALS

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

- B. LEED Submittals:

- 1. Credit MR 6.0: Product Data for rapidly renewable materials.
    - a. Include statement indicating costs for each rapidly renewable material.
  - 2. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.
  - 3. Product Data for Credit EQ 4.3: Low emitting materials, including printed statement of VOC content.

- C. Seam Samples: For seamless-installation technique indicated and for each floor covering product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.

- D. Qualification Data: For qualified Installer.

- E. Maintenance Data: For each type of floor covering to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation and seaming method indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by floor covering manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- C. Preinstallation Conference: Conduct conference at Project site.
  - 1. At least 7 days prior to starting installation of flooring, conduct a meeting to review detailed requirements for materials and to determine procedures for a satisfactory installation of flooring materials.
  - 2. Review methods and procedures related to curing and protection of concrete substrate.
  - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.

#### 1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive floor coverings during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install floor coverings after other finishing operations, including painting, have been completed.

#### 1.7 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. Floor Covering: Furnish quantity not less than 10 linear feet for every 500 linear feet or fraction thereof, in roll form and in full roll width for each color, pattern, and type of floor covering installed.

## PART 2 - PRODUCTS

### 2.1 LINOLEUM FLOOR COVERINGS (LFS)

- A. Linoleum: Where this designation is indicated, provide linoleum floor covering with backing complying with the following:
  1. Available Products: As follows:
    - a. Marmoleum by Forbo: As indicated from Dual Collections.
  2. Composition: Linseed oil, wood flour, rosin binders and dry pigments.
  3. Overall Thickness: 0.10 inch (2.5 mm).
  4. Wearing Surface: Smooth.
  5. Backing: Jute.
  6. Sheet Width: 6.5 feet.
  7. Seaming Method: Heat welded.
- B. Color and Pattern:
  1. LFS1:

### 2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.
  1. Use adhesives that have a VOC content of not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Seamless-Installation Accessories:
  1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
    - a. Color: Match floor covering.
- D. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.



## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 SUBSTRATE TESTING

- A. General: Conduct testing using an independent agency with a minimum of five years experience in moisture emission testing or as pre-approved by the manufacturer of the flooring material.
- B. Moisture Emission Testing: Conduct moisture emission testing of concrete slabs-on-grade and elevated slabs to receive floor coverings or coatings by the calcium chloride test method. Perform tests in accordance with ASTM F-1869.
  - 1. Conduct a minimum of three tests for the first 1,000 sq. ft. and one additional test for each additional 1,000 sq. ft.
  - 2. Ambient test environment shall conform to ASTM-1869 and be reflective of the building's normal operational environment.
  - 3. Conduct tests on bare concrete, free of surface contaminants, adhesives, curing compounds or sealers.
  - 4. Locate test locations a minimum of five feet from exterior walls or interior walls that penetrate the floor. Do not conduct tests over random cracks or within five feet of control or construction joints.
  - 5. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
- C. Internal Relative Humidity Testing: Conduct internal relative humidity testing of concrete slabs-on-grade and elevated slabs to receive floor coverings or coatings in accordance with ASTM F-2170.
  - 1. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- D. Surface Alkalinity Testing: Conduct alkalinity testing of the concrete surface at all moisture emission test locations in accordance with ASTM F710 5.3.1.
- E. Submit all test results to the Architect, flooring installer and manufacturer of the flooring materials before installation of the flooring materials.

## 3.3 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.
- B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor coverings until they are same temperature as space where they are to be installed.
1. Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

### 3.4 FLOOR COVERING INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor coverings.
- B. Unroll floor coverings and allow them to stabilize before cutting and fitting.
- C. Lay out floor coverings as follows:
1. Maintain uniformity of floor covering direction.
  2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in floor covering substrates.
  3. Match edges of floor coverings for color shading at seams.
  4. Avoid cross seams.
- D. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.
- E. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor coverings on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of floor coverings installed on covers and adjoining floor covering. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Seamless Installation:
1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.

## 3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.
- B. Perform the following operations immediately after completing floor covering installation:
  - 1. Remove adhesive and other blemishes from floor covering surfaces.
  - 2. Sweep and vacuum floor coverings thoroughly.
  - 3. Damp-mop floor coverings to remove marks and soil.
- C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor covering before applying liquid floor polish.
  - 1. Apply as recommended by manufacturer.
- E. Cover floor coverings until Substantial Completion.

END OF SECTION 096516

## SECTION 096519 - RESILIENT TILE FLOORING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:

- 1. Linoleum floor tile.
- 2. Rubber floor tile.

- B. Related Sections:

- 1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.
- 2. Division 09 Section "Resilient Sheet Flooring" for resilient sheet floor coverings.

## 1.3 SUBMITTALS

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

- B. LEED Submittals:

- 1. Credit MR 6.0: Product Data for rapidly renewable materials.
  - a. Include statement indicating costs for each rapidly renewable material.
- 2. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.
- 3. Product Data for Credit EQ 4.3: Low emitting materials, including printed statement of VOC content.

- C. Product Schedule: For floor tile. Use same designations indicated on Drawings.

- D. Maintenance Data: For each type of floor tile to include in maintenance manuals.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.

- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

- 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

- C. Preinstallation Conference: Conduct conference at Project site.
  - 1. At least 7 days prior to starting installation of flooring, conduct a meeting to review detailed requirements for materials and to determine procedures for a satisfactory installation of flooring materials.
  - 2. Review methods and procedures related to curing and protection of concrete substrate.
  - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

#### 1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

#### 1.7 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. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

### PART 2 - PRODUCTS

#### 2.1 LINOLEUM COMPOSITION FLOOR TILE (LFT)

- A. Products: Subject to compliance with requirements, provide the following:
  - 1. Marmoleum by Forbo: Dual.
- B. Wearing Surface: Smooth.

- C. Backing: Jute.
- D. Thickness: 2.5 mm.
- E. Size: 13 by 13 inches.
- F. Colors and Patterns:
  - 1. LFT1: 707 Barley.
  - 2. LFT2: 793 Cotswold.
  - 3. LFT3: 779 Sandstone.
  - 4. LFT4: 810 Flax.
  - 5. LFT5: 846 Royal Blue.
  - 6. LFT6: 767 Rust.
  - 7. LFT7: 475 Evergreen.
  - 8. LFT8: 421 Cool Green.
  - 9. LFT9: 784 Coffee.
  - 10. LFT10: 629 Eiger.
  - 11. LFT11: 345 Violet.
  - 12. LFT12: 607 White marble.

## 2.2 RUBBER FLOOR TILE (RFT)

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Roppe; 991 Slate Design.
- B. Tile Standard: ASTM F 1344, Class I-A, homogeneous rubber tile, solid color.
- C. Hardness: Not less than 85 as required by ASTM F 1344, measured using Shore, Type A durometer per ASTM D 2240.
- D. Wearing Surface: Textured.
- E. Thickness: 0.125 inch.
- F. Size: 20 by 20 inches nominal.
- G. Colors and Patterns: 401 Camello.

## 2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
  - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.

- b. Rubber Floor Adhesives: Not more than 60 g/L.
- C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 SUBSTRATE TESTING

- A. General: Conduct testing using an independent agency with a minimum of five years experience in moisture emission testing or as pre-approved by the manufacturer of the flooring material.
- B. Moisture Emission Testing: Conduct moisture emission testing of concrete slabs-on-grade and elevated slabs to receive floor coverings or coatings by the calcium chloride test method. Perform tests in accordance with ASTM F-1869.
  - 1. Conduct a minimum of three tests for the first 1,000 sq. ft. and one additional test for each additional 1,000 sq. ft.
  - 2. Ambient test environment shall conform to ASTM-1869 and be reflective of the building's normal operational environment.
  - 3. Conduct tests on bare concrete, free of surface contaminants, adhesives, curing compounds or sealers.
  - 4. Locate test locations a minimum of five feet from exterior walls or interior walls that penetrate the floor. Do not conduct tests over random cracks or within five feet of control or construction joints.
  - 5. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
- C. Internal Relative Humidity Testing: Conduct internal relative humidity testing of concrete slabs-on-grade and elevated slabs to receive floor coverings or coatings in accordance with ASTM F-2170.
  - 1. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- D. Surface Alkalinity Testing: Conduct alkalinity testing of the concrete surface at all moisture emission test locations in accordance with ASTM F710 5.3.1.
- E. Submit all test results to the Architect, flooring installer and manufacturer of the flooring materials before installation of the flooring materials.

### 3.3 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until they are same temperature as space where they are to be installed.
  - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

### 3.4 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles square with room axis, unless a pattern is indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles with grain running in one direction and in pattern of colors and sizes indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings and under lockers.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.



- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### 3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.
  - 1. Apply as recommended by the manufacturer.
- E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

## SECTION 096566 - RESILIENT ATHLETIC FLOORING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Resilient Athletic Flooring.

## 1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data, application instructions and general recommendations.
- B. Shop Drawing: Provide drawing indicating floor termination details and game line layout.
- C. Samples for Selection: Submit two samples, 8 x 4 inch (200 x 100 mm) in size illustrating color and texture for each floor material for each color specified.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- E. Manufacturers maintenance instructions.
- F. LEED Submittal:
  - 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
  - 2. Credit MR 5.1: Product Data indicating location of material manufacturer for regionally manufactured materials.
    - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.
  - 3. Credit EQ 4.1: Manufacturers' product data for interior sealants, including printed statement of VOC content and material safety data sheets.

## 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer approved Installer, who has technical qualifications, currently certified in writing, and facilities to install specified systems.
- B. Preinstallation Conference: Conduct conference at Project site.

1. At least 7 days prior to starting installation of flooring, conduct a meeting to review detailed requirements for materials and to determine procedures for a satisfactory installation of flooring materials.
2. Review methods and procedures related to curing and protection of concrete substrate.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 55 and 80 deg F.
- B. Store rolls upright.

#### 1.5 PROJECT CONDITIONS

- A. Concrete and Concrete Finishing
  1. Concrete tolerance 1/8" in radius of 10'
  2. Surface must be steel troweled smooth
  3. Concrete shall be 2,500 – 3,000 psi compressive strength after 28 days.
  4. Concrete shall be free of washed river gravel, pea gravel, flint, hardener additives, or curing compounds.
  5. No lightweight concrete.
- B. Do not install floor system until concrete has been cured 60 days.
- C. Permanent heat, light and ventilation shall be installed and operating during and after installation. Maintaining a temperature range of 55 to 80 degrees Fahrenheit and a relative humidity range of 35 to 50%.
- D. After floors are finished, area is to be kept locked by General Contractor to allow curing time for the finish. If after required curing time the General Contractor requires use of the area, General Contractor shall protect the floor by covering with non-fibered kraft paper or red rosin paper with taped joints, until acceptance by Owner of complete gymnasium floor.

#### 1.6 WARRANTY

- A. Guarantee shall not cover damage caused in whole or in part by casualty, ordinary wear and tear, abuse, use for which the materials are not designed, faulty construction of the building, settlement of the building walls, failure of the other contractors to adhere to specifications, separation of the concrete slab and excessive dryness or excessive moisture from humidity, spillage, migration through the slab or wall, or any other source.
- B. The manufacturer hereby warrants the floor systems material to be free from manufacturing defects for a period of five (5) years. This warranty is in lieu of all other warranties, expressed or implied, including but not limited to any warranty of merchantability or fitness for a particular purpose, and of any other obligations on the part of the manufacturer. In the event of breach of any warranty, the liability of the manufacturer shall be limited to repairing or replacing the DD Lino Floor systems. Material and system components supplied by the manufacturer and proven to be defective in manufacture, and shall not include any other damages, either direct or consequential.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Provide the following:

1. Mats, Inc.: DD Linopol.

## 2.2 MATERIALS

A. Composition of Finish Flooring: 4 mm thick linoleum with a jute backing.

1. Width: 6'-7".
2. Length: 88'-6" to 95'.

2.3 Vapor Barrier: 6mil polyethylene

2.4 Elastic Underlayment: 6 mm, PUR bound polyester foam granules.

## 2.5 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.

B. Adhesives: Provide adhesive per manufacturer recommendations.

C. Base: Refer to Division 09 Section "Resilient Base and Accessories for wall base used with floor materials.

D. Transitions: Refer to Division 09 Section "Resilient Base and Accessories for transitions to adjacent floor materials.

## 2.6 COLORS

A. Color as selected by Architect from manufacturer's full line of color options including wood grain options.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine substrates, areas, and conditions where installation of products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs cured a minimum 60 days and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer.

2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 SUBSTRATE TESTING

- A. General: Conduct testing using an independent agency with a minimum of five years experience in moisture emission testing or as pre-approved by the manufacturer of the flooring material.
- B. Moisture Emission Testing: Conduct moisture emission testing of concrete slabs-on-grade and elevated slabs to receive floor coverings or coatings by the calcium chloride test method. Perform tests in accordance with ASTM F-1869.
1. Conduct a minimum of three tests for the first 1,000 sq. ft. and one additional test for each additional 1,000 sq. ft.
  2. Ambient test environment shall conform to ASTM-1869 and be reflective of the building's normal operational environment.
  3. Conduct tests on bare concrete, free of surface contaminants, adhesives, curing compounds or sealers.
  4. Locate test locations a minimum of five feet from exterior walls or interior walls that penetrate the floor. Do not conduct tests over random cracks or within five feet of control or construction joints.
  5. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
- C. Internal Relative Humidity Testing: Conduct internal relative humidity testing of concrete slabs-on-grade and elevated slabs to receive floor coverings or coatings in accordance with ASTM F-2170.
1. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- D. Surface Alkalinity Testing: Conduct alkalinity testing of the concrete surface at all moisture emission test locations in accordance with ASTM F710 5.3.1.
- E. Submit all test results to the Architect, flooring installer and manufacturer of the flooring materials before installation of the flooring materials.

### 3.3 PREPARATION

- A. Remove grease, oil, and other penetrating contaminants. Repair damaged and deteriorated concrete to acceptable condition. Leave surface free of dust, dirt, laitance, and efflorescence.
- B. Moving cracks and joints shall be thoroughly routed and vacuumed clean, then filled with approved material.
- C. Vacuum clean substrate.

### 3.4 INSTALLATION

- A. Follow all manufacturer's installation instructions.

- B. Install elastic mat over entire floor and glue to substrate as recommended by manufacturer. Roll and hammer edges as recommended.
- C. Lay out sheets of Linoleum by roll number.
- D. Glue linoleum flooring to elastic mat.
- E. Underscribe and cut edge and ends of rolls.
- F. Roll floor with roller.
- G. Heat weld seams, and trim.
- H. Game Lines: All court lines shall be applied using the compounded polyurethane paint as approved by Manufacturer. Colors to be selected from the standard color chart.

### 3.5 CLEANING AND PROTECTING

- A. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.
- B. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.

END OF SECTION 096566

## SECTION 096813 - TILE CARPETING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes modular, tufted carpet tile.
- B. Related Sections include the following:
  - 1. Division 09 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.
  - 2. Division 09 Section "Sheet Carpeting" for broadloom carpet types.
  - 3. Division 12 Section "Entrance Floor Mats and Frames" for carpet tile CPT-1 used for entrance mat.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.
- B. LEED Submittal:
  - 1. Product Data for Credit EQ 4.3:
    - a. For carpet tile, documentation indicating compliance with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.
    - b. For installation adhesive, including printed statement of VOC content.
- C. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- D. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
  - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- E. Warranty: Special warranty specified in this Section.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

#### 1.6 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

#### 1.7 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
  - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
  - 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, and delamination.
  - 3. Warranty Period: 10 years from date of Substantial Completion.

#### 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

### PART 2 - PRODUCTS

#### 2.1 CARPET TILE (CPT4 & CPT8)

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



1. Jimi Tile by Shaw.
  - a. Color: CPT4; Pine 49300.
  - b. Color: CPT8; Urchin 49305.
- B. Fiber Content: 100% eco solution q® Premium Branded Nylon.
- C. Dye Method: Solution dyed.
- D. Pile Characteristic: Multilevel Pattern-loop pile.
- E. Pile Average Height: 0.194 inches.
- F. Stitches: 12 per inch.
- G. Gage: 1/12.
- H. Total Weight: 38 oz./sq. yd.
- I. Backing System: Ecoworx®.
- J. Size: 24 by 24 inches.
- K. Applied Soil-Resistance Treatment: Manufacturer's standard material.
- L. Antimicrobial Treatment: Manufacturer's standard material.
- M. Performance Characteristics: As follows:
  1. Flooring Radiant Panel: NFPA-253 (ASTM E648) Direct Glue Down Mode – Class 1
  2. NBS Smoke Chamber: NFPA-258 (ASTM E662) Flaming Mode – 450 or less
  3. Static Propensity: 3.5 KV or less.
  4. Environmental Requirements: Provide carpet tile that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

## 2.2 CARPET TILE (CPT5 & CPT7)

- A. Products: Subject to compliance with requirements, provide one of the following:
  1. Haven Tile by Shaw.
    - a. Color: CPT5; Peacock 49725.
    - b. Color: CPT6; Urchin 49305.
  - B. Fiber Content: 100% eco solution q® Premium Branded Nylon.
  - C. Dye Method: Solution dyed.
  - D. Pile Characteristic: Multilevel Pattern-loop pile.
  - E. Pile Average Height: 0.172 inches.
  - F. Stitches: 11.5 per inch.

- G. Gage: 1/12.
- H. Total Weight: 38 oz./sq. yd.
- I. Backing System: Ecoworx®.
- J. Size: 24 by 24 inches.
- K. Applied Soil-Resistance Treatment: Manufacturer's standard material.
- L. Antimicrobial Treatment: Manufacturer's standard material.
- M. Performance Characteristics: As follows:
  - 1. Flooring Radiant Panel: NFPA-253 (ASTM E648) Direct Glue Down Mode – Class 1
  - 2. NBS Smoke Chamber: NFPA-258 (ASTM E662) Flaming Mode – 450 or less
  - 3. Static Propensity: 3.5 KV or less.
  - 4. Environmental Requirements: Provide carpet tile that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

### 2.3 CARPET TILE (CPT6)

- A. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Casco Tile by Shaw.
    - a. Color: CPT6; Urchin 49305.
- B. Fiber Content: 100% eco solution q® Premium Branded Nylon.
- C. Dye Method: Solution dyed.
- D. Pile Characteristic: Multilevel Pattern-loop pile.
- E. Pile Average Height: 0.169 inches.
- F. Stitches: 11 per inch.
- G. Gage: 1/12.
- H. Total Weight: 38 oz./sq. yd.
- I. Backing System: Ecoworx®.
- J. Size: 24 by 24 inches.
- K. Applied Soil-Resistance Treatment: Manufacturer's standard material.
- L. Antimicrobial Treatment: Manufacturer's standard material.
- M. Performance Characteristics: As follows:
  - 1. Flooring Radiant Panel: NFPA-253 (ASTM E648) Direct Glue Down Mode – Class 1
  - 2. NBS Smoke Chamber: NFPA-258 (ASTM E662) Flaming Mode – 450 or less

3. Static Propensity: 3.5 KV or less.
4. Environmental Requirements: Provide carpet tile that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

#### 2.4 CARPET TILE (CPT9)

- A. Products: Subject to compliance with requirements, provide one of the following:
  1. Portland Tile by Shaw.
    - a. Color: Urchin 49305.
- B. Fiber Content: 100% eco solution q® Premium Branded Nylon.
- C. Dye Method: Solution dyed.
- D. Pile Characteristic: Multilevel Pattern-loop pile.
- E. Pile Average Height: 0.123 inches.
- F. Stitches: 11.16 per inch.
- G. Gage: 1/10.
- H. Total Weight: 38 oz./sq. yd.
- I. Backing System: Ecoworx®.
- J. Size: 24 by 24 inches.
- K. Applied Soil-Resistance Treatment: Manufacturer's standard material.
- L. Antimicrobial Treatment: Manufacturer's standard material.
- M. Performance Characteristics: As follows:
  1. Flooring Radiant Panel: NFPA-253 (ASTM E648) Direct Glue Down Mode – Class 1
  2. NBS Smoke Chamber: NFPA-258 (ASTM E662) Flaming Mode – 450 or less
  3. Static Propensity: 3.5 KV or less.
  4. Environmental Requirements: Provide carpet tile that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

#### 2.5 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
  1. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
  - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
  - 2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
  - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

## 3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

#### 3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
  - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
  - 2. Remove yarns that protrude from carpet tile surface.
  - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

## SECTION 096816 - SHEET CARPETING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Tufted carpet.
- B. Related Sections include the following:
  - 1. Division 02 Section "Selective Structure Demolition" for removing existing floor coverings.
  - 2. Division 09 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet.
  - 3. Division 09 Section "Tile Carpeting."

## 1.3 SUBMITTALS

- A. Product Data: For the following, including installation recommendations for each type of substrate:
  - 1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
- B. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
  - 1. Carpet: 12-inch- square Sample.
  - 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- long Samples.
  - 3. Carpet Seam: 6-inch Sample.
- C. LEED Submittals:
  - 1. Product Data for Credit EQ 4.3:
    - a. For carpet, documentation indicating compliance with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.
    - b. For installation adhesive, including printed statement of VOC content.
- D. Product Schedule: For carpet Use same designations indicated on Drawings.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

- F. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
  - 1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  - 2. Precautions for cleaning materials and methods that could be detrimental to carpet.
- G. Warranties: Special warranties specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Seam Sample: Before installing carpet, provide a seam sample to set quality standards for materials and execution.
  - 1. Approved sample may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to carpet installation including, but not limited to, the following:
  - 1. Review delivery, storage, and handling procedures.
  - 2. Review ambient conditions and ventilation procedures.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

#### 1.6 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

## 1.7 WARRANTY

- A. Special Warranty for Carpet: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
  2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, excess static discharge, Insert failure characteristic and delamination.
  3. Warranty Period: 10 years from date of Substantial Completion.

## 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Carpet: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

## PART 2 - PRODUCTS

## 2.1 TUFTED CARPET (CPT2)

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Casco by Shaw Contract Group.
    - a. Color: 96300 Pine.
  - B. Fiber Content: 100% eco solution q® Premium Branded Nylon.
  - C. Pile Characteristic: Multilevel-loop pile.
  - D. Pile Thickness: 0.169 inches.
  - E. Stitches: 9.5 per inch.
  - F. Gage: 1/12.
  - G. Face Weight: 36 oz./sq. yd.
  - H. Primary Backing: Manufacturer's standard material.
  - I. Secondary Backing: Ultraloc® Pattern.
  - J. Width: 12 feet.
  - K. Pattern Repeat: 6' wide by 5' long.
  - L. Applied Soil-Resistance Treatment: Manufacturer's standard material.



- M. Antimicrobial Treatment: Manufacturer's standard material.
- N. Performance Characteristics: As follows:
  1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
  2. Electrostatic Propensity: Less than 3.5 kV per AATCC 134.
  3. Environmental Requirements: Provide carpet that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

## 2.2 TUFTED CARPET (CPT3)

- A. Products: Subject to compliance with requirements, provide one of the following:
  1. Munjoy by Shaw Contract Group.
    - a. Color: 96200 Citron.
- B. Fiber Content: 100% eco solution q@ Premium Branded Nylon.
- C. Pile Characteristic: Multilevel-loop pile.
- D. Pile Thickness: 0.177 inches.
- E. Stitches: 9.0 per inch.
- F. Gage: 1/12.
- G. Face Weight: 34 oz./sq. yd.
- H. Primary Backing: Manufacturer's standard material.
- I. Secondary Backing: Ultraloc® Pattern.
- J. Width: 12 feet.
- K. Pattern Repeat: 4' wide by 3' long.
- L. Applied Soil-Resistance Treatment: Manufacturer's standard material.
- M. Antimicrobial Treatment: Manufacturer's standard material.
- N. Performance Characteristics: As follows:
  1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
  2. Electrostatic Propensity: Less than 3.5 kV per AATCC 134.
  3. Environmental Requirements: Provide carpet that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

## 2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet manufacturer.

- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.
  - 1. VOC Limits: Provide adhesives with VOC content not more than 50g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
- C. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
- D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
  - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet[ **cushion**] manufacturer.
  - 2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet.
  - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. General: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

### 3.3 INSTALLATION

- A. Comply with CRI 104 and carpet manufacturer's written installation instructions for the following:
  - 1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."
- B. Comply with carpet manufacturer's written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- C. Do not bridge building expansion joints with carpet.
- D. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- E. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, "Patterned Carpet Installations" and with carpet manufacturer's written recommendations.

### 3.4 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing carpet:
  - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
  - 2. Remove yarns that protrude from carpet surface.
  - 3. Vacuum carpet using commercial machine with face-beater element.
- B. Protect installed carpet to comply with CRI 104, Section 16, "Protection of Indoor Installations."
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet adhesive manufacturer.

END OF SECTION 096816

## SECTION 098413 - FIXED SOUND-ABSORPTIVE PANELS

## 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 panel types:
  - 1. Wood-fiber acoustical wall panels.
  - 2. Fabric faced, glass fiberboard acoustical wall panels.
- B. Related Sections include the following:
  - 1. Division 09 Section "Acoustical Panel Ceilings" for acoustical ceiling panels supported by exposed suspension system and tested for noise reduction.

## 1.3 DEFINITIONS

- A. NRC: Noise reduction coefficient.

## 1.4 SUBMITTALS

- A. Product Data: For each type of panel edge, core material, and mounting indicated.
- B. LEED Submittals:
  - 1. Product Data for Credit EQ 4.4:
    - a. For each composite-wood product used, documentation indicating that the bonding agent contains no urea formaldehyde.
    - b. For each adhesive used, documentation indicating that the adhesive contains no urea formaldehyde.
  - 2. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content
    - a. Include statement indicating costs for each product having recycled content.
  - 3. Certificates for Credit MR 7: Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include evidence that mill is certified for chain of custody by an FSC-accredited certification body.
    - a. Include statement indicating costs for each certified wood product.

- C. Shop Drawings: For acoustical wall panels. Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Include elevations showing panel sizes and direction of fabric weave and pattern matching. Indicate panel edge and core materials.
- D. Samples for Selection: For each type of fabric facing material from acoustical wall panel manufacturer's full range.
- E. Maintenance Data: For acoustical wall panels to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.
- F. Warranty: Special warranty specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Source Limitations: Obtain acoustical wall panels through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide acoustical wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- D. Forest Certification: 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. Wood-fiber acoustic panels.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and acoustical wall panel manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.
- C. Protect panel edges from crushing and impact.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical wall panels until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install acoustical wall panels until a lighting level of not less than 50 fc is provided on surfaces to receive acoustical wall panels.

- C. Air-Quality Limitations: Protect acoustical wall panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify locations of acoustical wall panels by field measurements before fabrication and indicate measurements on Shop Drawings.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of acoustical wall panels that fail in performance, materials, or workmanship within specified warranty period.
  - 1. Failure in performance includes, but is not limited to, acoustical performance.
  - 2. Failures in materials include, but are not limited to, fabric sagging, distorting, or releasing from panel edge; or warping of core.
  - 3. Warranty Period: Two years from date of Substantial Completion.

## 1.9 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fabric: For each fabric, color, and pattern installed, provide length equal to 10 percent of amount installed, but no fewer than 10 yards.
  - 2. Acoustical Wall Panel Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than 5 attachment devices.

## PART 2 - PRODUCTS

### 2.1 WOOD-FIBER ACOUSTICAL WALL PANELS (AWP-1)

- A. Recycled Content: Provide product with 40 percent post consumer recycled content by value.
- B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
  - 1. "Tectum Finale Wall Panels" as manufactured by Tectum, Inc.
- C. Fabricate panels to sizes and configurations indicated.
  - 1. AWP-1: 31-3/4 by 144 inch.
- D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:
  - 1. Thickness.
  - 2. Edge straightness.
  - 3. Overall length and width.
  - 4. Squareness from corner to corner.
- E. Sound-Absorption Performance: Provide acoustical wall panels with minimum noise reduction coefficients of .75, as determined by testing per ASTM C 423 for mounting type specified.

- F. Panel Characteristics: 1 inch thick, wood fiber panels with long edges beveled.
- G. Color: Natural.
- H. Furring: 3/4 inch thick, wood fiber furring with SoniCor fiber core between the furring.
- I. Mounting Style: "C-20".

## 2.2 GLASS FIBERBOARD ACOUSTICAL WALL PANELS (AWP-2 and AWP-3)

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
  - 1. AWP-2: Respond Fabric Wrapped Acoustic High Impact Panel as manufactured by Conweb Designscape.
  - 2. AWP-3: Respond Fabric Wrapped Acoustic Panel as manufactured by Conweb Designscape.
- B. Fabricate panels to sizes and configurations indicated on the drawings.
- C. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:
  - 1. Thickness.
  - 2. Edge straightness.
  - 3. Overall length and width.
  - 4. Squareness from corner to corner.
- D. Sound-Absorption Performance: Provide acoustical wall panels with minimum noise reduction coefficients of .75, as determined by testing per ASTM C 423 for mounting type specified.
- E. Panel Characteristics: 1-1/8 inch thick, glass fiberboard panels with fabric returned at edges to back.
- F. Fabric Covering:
  - 1. AWP-2a: Mafaram Giga Point by Bruce Mau, 901530 color 002 Ecrú.
  - 2. AWP-2b: Mafaram Mega Point by Bruce Mau, 901510 Meganano color 002 Ecrú.
  - 3. AWP-3: Guildford or Maine, FR701, 748 Bone.
- G. Mounting Style: Z clip.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fabric, substrates, blocking, and conditions, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of acoustical wall panels.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
  - 1. Cut units to be at least 50 percent of unit width, with facing material extended over cut edge to match uncut edge. Scribe acoustical wall panels to fit adjacent work. Butt joints tightly.
- B. Comply with acoustical wall panel manufacturer's written instructions for installation of panels using type of concealed mounting accessories indicated or, if not indicated, as recommended by manufacturer. Anchor panels securely to supporting substrate.
- C. Match and level fabric pattern and grain among adjacent panels.
- D. Installation Tolerances: As follows:
  - 1. Variation from Level and Plumb: Plus or minus 1/16 inch.
  - 2. Variation of Panel Joints from Hairline: Not more than 1/16 inch wide.

### 3.3 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels with fabric facing, on completion of installation, to remove dust and other foreign materials according to manufacturer's written instructions.

### 3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that acoustical wall panels are without damage or deterioration at time of Substantial Completion.
- B. Replace acoustical wall panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 098413



## SECTION 099113 - EXTERIOR 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 surface preparation and the application of paint systems on the following exterior substrates:
  - 1. Steel.
- B. Related Sections include the following:
  - 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
  - 2. Division 08 Sections for factory priming doors with primers specified in this Section.
  - 3. Division 09 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each type of paint system and each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 8 inches square.
- C. Product List: For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

## 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

## 1.5 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

#### 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
  - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturer: The Portland Public School Department would like the following manufacturer:
  - 1. ICI Paints.

#### 2.2 PAINT, GENERAL

- A. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: Provide color selections made by the Architect. Allow for up to 5 different color selections.

#### 2.3 METAL PRIMERS

- A. Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.
  - 1. ICI Paint; 4020-XXXX, Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish. Applied at a dry film thickness of not less than 2.0 mils.
- B. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.
  - 1. ICI Paint; 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish: Applied at a dry film thickness of not less than 2.2 mils.

#### 2.4 EXTERIOR LATEX PAINTS

- A. Exterior Semi-Gloss Acrylic Enamel: Factory-formulated semi-gloss acrylic enamel for exterior application.

1. ICI Paint; 4206-XXXX Devflex Interior/Exterior Acrylic Semi-Gloss Enamel: Applied at a dry film thickness of not less than 2.0 mils.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

#### 3.2 PREPARATION

- A. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- B. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- C. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

#### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
  1. Use applicators and techniques suited for paint and substrate indicated.
  2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 EXTERIOR PAINTING SCHEDULE

- A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
  - 1. Semi-Gloss Acrylic-Enamel Finish: Two finish coats over a rust-inhibitive primer.
    - a. Primer: Exterior ferrous-metal primer.
    - b. Finish Coats: Exterior semi-gloss acrylic enamel.
- B. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
  - 1. Semi-Gloss Acrylic-Enamel Finish: Two finish coats over a rust-inhibitive primer.
    - a. Primer: Exterior galvanized metal primer.
    - b. Finish Coats: Exterior semi-gloss acrylic enamel.

END OF SECTION 099113

## SECTION 099123 - INTERIOR 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 surface preparation and the application of paint systems on the following interior substrates:
  - 1. Concrete masonry units (CMU).
  - 2. Steel.
  - 3. Wood.
  - 4. Gypsum board.
- B. Related Sections include the following:
  - 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
  - 2. Division 08 Sections for factory priming doors with primers specified in this Section.
  - 3. Division 09 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittal:
  - 1. Product Data for Credit EQ 4.2: For paints, including printed statement of VOC content and chemical components.
- C. Samples: Provide color chips of colors specified.
- D. Product List: For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

## 1.4 QUALITY ASSURANCE

- A. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
  - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft..
  - b. Other Items: Architect will designate items or areas required.
2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.
  - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

#### 1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
  1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturer: ICI Paints. No substitutions.

#### 2.2 PAINT, GENERAL

- A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors:

1. PT-1 30YY 67/194 Ivory Cream
2. PT-2 10YY 26/321 Country Store
3. PT-3 30BG 37/110 Seacliff
4. PT-4 30BB 27/236 Dream Spiral
5. PT-5 10YY 45/419 Wood Thrush
6. PT-6 80 YR 31/419 Golden Nectar
7. PT-7 90YY 48/255 Serengeti
8. PT-8 90GY 16/151 Ivy
9. PT-9 70BB 35/108 Approaching Night
10. PT-10 70BB 14/202 Contentment
11. PT-11 98YY 82/022 White High-Hiding RM
12. PT-12 37YY 61/877 Sunny Side Up
13. PT-13: 00NN 05/000 Dark Secret

### 2.3 BLOCK FILLERS

- A. Concrete Unit Masonry Block Filler: Factory-formulated high-performance latex block fillers.
1. Devoe Coatings: Bloxfill 4000.

### 2.4 BLOCK FILLERS FOR EPOXY PAINT

- A. Concrete Unit Masonry Block Filler: Factory-formulated high-performance latex block fillers.
1. Devoe Coatings: Bloxfill 4000.

### 2.5 PRIMERS/SEALERS

- A. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
1. ICI Paint; LifeMaster 2000 Interior Primer-Sealer, LM9116.

### 2.6 METAL PRIMERS

- A. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive acrylic-based metal primer.
1. ICI Paint; 4020-1000, Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish. Applied at a dry film thickness of not less than 2.0 mils.

## 2.7 WOOD PRIMERS

- A. Interior Wood Primer for Acrylic-Enamel Finishes: Factory-formulated acrylic-latex-based interior wood primer.

## 2.8 LATEX PAINTS

- A. Interior Flat Acrylic Paint: Factory-formulated flat acrylic-emulsion latex paint for interior application.
  - 1. ICI: Dulux® LifeMaster Flat Interior Latex Enamel 9100.
- B. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel.
  - 1. ICI: Dulux® LifeMaster Eggshell Interior Latex Enamel 9300
- C. Interior Semigloss Acrylic Enamel: Factory-formulated semigloss acrylic-latex enamel for interior application.
  - 1. ICI: Dulux® LifeMaster Semi-Gloss Interior Latex Enamel 9200

## 2.9 EPOXY PAINTS

- A. Semigloss, Polyamide Epoxy Finish: 2 finish coats over a primer or block filler.
  - 1. ICI: 4426-XXXX, Tru-Glaze-WB Waterborne Epoxy Semi-Gloss Coating

## 2.10 INTERIOR WOOD STAINS AND VARNISHES

- A. Interior Polyurethane-Based Clear Satin Varnish: Factory-formulated polyurethane-based clear varnish.
  - 1. ICI Paint; 1802-1000 WoodPride WB Interior Satin Polyurethane Varnish.

## 2.11 DRY FOG/FALL COATINGS

- A. Interior Flat Modified Alkyd: Factory-formulated modified alkyd or epoxy for interior application.
  - 1. ICI: 4382-1000, Uni-Grip Modified Epoxy Eggshell Dry Fog Primer & Finish.

## 2.12 FLOOR COATINGS

- A. Latex Floor and Porch Paint (Low-Luster):
  - 1. ICI: 3018-XXXX Groundworks Interior/Exterior Water-Based Porch & Floor Satin Enamel. (43 g/L)



## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Masonry (Clay and CMU): 12 percent.
  - 3. Wood: 15 percent.
  - 4. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

## 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
  - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- F. Wood Substrates:
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Sand surfaces that will be exposed to view, and dust off.
  - 3. Prime edges, ends, faces, undersides, and backsides of wood.

4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- G. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
1. Use applicators and techniques suited for paint and substrate indicated.
  2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
1. Mechanical Work:
    - a. Uninsulated metal piping.
    - b. Uninsulated plastic piping.
    - c. Pipe hangers and supports.
    - d. Tanks that do not have factory-applied final finishes.
    - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
    - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
  2. Electrical Work:
    - a. Switchgear.
    - b. Panelboards.
    - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 INTERIOR PAINTING SCHEDULE

#### A. Concrete Substrates, Traffic Surfaces:

- 1. Latex Floor Coating System:
  - a. Prime Coat: Latex floor and porch paint (low gloss).
  - b. Intermediate Coat: Latex floor and porch paint (low gloss).
  - c. Topcoat: Latex floor and porch paint (low gloss).

#### B. Concrete Unit Masonry: Provide the following finish systems over interior concrete masonry:

- 1. Semigloss Acrylic-Enamel Finish: Two finish coats over block filler.
  - a. Block Filler: Concrete unit masonry block filler.
  - b. Finish Coats: Interior semigloss acrylic enamel.
- 2. Semigloss, Polyamide Epoxy Finish: Two finish coats over block filler. Provide epoxy finish on CMU in Corridors, Toilets, Lockers and Stairs.
  - a. Block Filler: Concrete unit masonry block filler.
  - b. Finish Coats: Semigloss, Polyamide Epoxy Finish.

#### C. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

- 1. Ceilings and Soffits, Flat Acrylic Finish: Two finish coats over a primer.
  - a. Primer: Interior gypsum board primer.
  - b. Finish Coats: Interior flat acrylic paint.
- 2. Walls, Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
  - a. Primer: Interior gypsum board primer.
  - b. Finish Coats: Interior low-luster acrylic enamel.
- 3. Walls, Semigloss, Polyamide Epoxy Finish: Two finish coats over a primer. Provide epoxy finish on CMU in Corridors, Toilets, Lockers and Stairs.
  - a. Primer: Interior gypsum board primer.
  - b. Finish Coats: Semigloss, Polyamide Epoxy Finish.

#### D. Wood: Provide the following paint finish systems over new interior wood surfaces:

- 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a wood undercoater.

- a. Primer: Interior wood primer for acrylic-enamel and semigloss alkyd-enamel finishes.
  - b. Finish Coats: Interior semigloss acrylic enamel.
- E. Clear Wood Finish: Provide the following varnish finish systems over new interior wood surfaces:
- 1. Satin Finish: Two finish coats over a wood sealer.
    - a. Sealer: Interior clear sanding sealer.
    - b. Finish Coats: Interior clear satin varnish.
- F. Ferrous Metal: Provide the following finish systems over ferrous metal:
- 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
    - a. Primer: Interior ferrous-metal primer.
    - b. Finish Coats: Interior semigloss acrylic enamel.
- G. Exposed Steel Beams, Joists and Deck:
- 1. Interior Flat Modified Alkyd (Dry Fog/Fall): One finish coat over shop primed materials.
    - a. Finish Coats: Interior Flat Modified Alkyd.

END OF SECTION 099123

## SECTION 101100 - VISUAL DISPLAY SUFACES

## 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. Porcelain enamel markerboards.
  - 2. Tackboards.
  - 3. Tack strips.

## 1.3 SUBMITTALS

- A. Product Data: For each type of visual display board indicated.
- B. Shop Drawings: For each type of visual display board required.
  - 1. Include dimensioned elevations. Show location of joints between individual panels where unit dimensions exceed maximum panel length.
  - 2. Include sections of typical trim members.
  - 3. Show anchors, grounds, reinforcement, accessories, layout, and installation details.
- C. Samples for Selection: Manufacturer's color charts showing the full range of colors and textures available.

## 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain visual display boards through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of visual display boards and are based on the products indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 01 Section "Product Requirements."
  - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.

## 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify field measurements before preparation of Shop Drawings and before fabrication to ensure proper fitting. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.
  - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating markerboards without field measurements. Coordinate wall construction to ensure actual dimensions correspond to established dimensions.

## 1.6 WARRANTY

- A. General Warranty: The special porcelain enamel markerboard warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Porcelain Enamel Markerboard Warranty: Submit a written warranty executed by manufacturer agreeing to replace porcelain enamel markerboards that do not retain their original writing and erasing qualities, become slick and shiny, or exhibit crazing, cracking, or flaking within the specified warranty period, provided the manufacturer's written instructions for handling, installation, protection, and maintenance have been followed.
  - 1. Warranty Period: 50 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Aarco Products, Inc.
  - 2. Claridge Products and Equipment, Inc.
  - 3. Ghent Manufacturing, Inc.
  - 4. Polyvision.

### 2.2 MATERIALS

- A. Porcelain Enamel Markerboards: Balanced, high-pressure-laminated, porcelain enamel markerboards of 3-ply construction consisting of face sheet, core material, and backing.
  - 1. Face Sheet: Porcelain-enamel-clad, ASTM A 463/A 463M, Type 1, stretcher-leveled aluminized steel, with 0.0236-inch uncoated thickness; with porcelain-enamel coating fused to steel at approximately 1000 deg F.
    - a. Gloss Finish: Low gloss; dry-erase markers wipe clean with dry cloth or standard eraser. Suitable for use as projection screen.

2. Core: 3/8-inch- thick, particleboard core material complying with requirements of ANSI A208.1, Grade 1-M-1.
  3. Backing Sheet: 0.015-inch- thick, aluminum-sheet backing.
  4. Laminating Adhesive: Manufacturer's standard, moisture-resistant, thermoplastic-type adhesive.
  5. Custom Lining: Where indicated, provide four sets of music staff lines plus two treble notes and two bass clef notes.
- B. Natural-Cork Tackboard: 1/16-inch- thick, natural cork sheet factory laminated to 7/16-inch- thick fiberboard backing.
- C. Tack Strips: Aluminum channel gripping mechanism and cork insert designed to hold posters and papers in place without tacking.
1. Available Product: Claridge No. 79 Hang-Tight Rail System or approved substitute.

### 2.3 ACCESSORIES

- A. Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062-inch- thick, extruded-aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units. Keep joints to a minimum. Miter corners to a neat, hairline closure.
1. Factory-Built Units: Manufacturer's standard slip-on trim mounted to units of required size, 5/8 inch wide trim.
  2. Chalktray: Manufacturer's standard, continuous, solid, extrusion-type, aluminum chalktray with ribbed section and smoothly curved exposed ends for each markerboard.
  3. Map Rail: Furnish map rail at top of each unit.

### 2.4 FABRICATION

- A. Porcelain Enamel Markerboards: Laminate facing sheet and backing sheet to core material under pressure with manufacturer's recommended flexible, waterproof adhesive.
- B. Assembly: Provide factory-assembled markerboard units, unless field-assembled units are required.
1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
  2. Provide manufacturer's standard vertical joint system between abutting sections of markerboards.

### 2.5 FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine wall surfaces, with Installer present, for compliance with requirements and other conditions affecting installation of visual display boards.
  - 1. Surfaces to receive markerboards shall be free of dirt, scaling paint, and projections or depressions that would affect smooth, finished surfaces of markerboards.
  - 2. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Deliver factory-built visual display boards completely assembled in one piece without joints, where possible. If dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.
- B. Install units in locations and at mounting heights indicated and according to manufacturer's written instructions. Keep perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- C. Coordinate units with grounds, trim, and accessories. Join parts with a neat, precision fit.

### 3.3 ADJUSTING AND CLEANING

- A. Verify that accessories required for each unit have been properly installed and that operating units function properly.
- B. Clean units according to manufacturer's written instructions.

END OF SECTION 101100



## SECTION 101400 - SIGNAGE

## 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. Plaques.
  - 2. Dimensional characters.
- B. Related Sections include the following:
  - 1. Division 01 Section "Allowances" for additional signs.
  - 2. Division 14 Section "Hydraulic Elevators" for code-required elevator signage.
  - 3. Division 22 Section "Identification for Plumbing Piping and Equipment" for labels, tags, and nameplates for plumbing systems and equipment.
  - 4. Division 23 Section "Identification for HVAC Piping and Equipment" for labels, tags, and nameplates for HVAC systems and equipment.
  - 5. Division 26 Sections for electrical service and connections for illuminated signs.
  - 6. Division 26 Section "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.
  - 7. Division 26 Section "Interior Lighting" for illuminated Exit signs.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for signs.
  - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
  - 2. Provide message list, typestyles, graphic elements and layout for each sign.
- C. Samples for Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following:
  - 1. Aluminum.
- D. Sign Schedule: Use same designations indicated on Drawings.
- E. Maintenance Data: For signs to include in maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.

#### 1.5 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.6 COORDINATION

- A. Coordinate placement of anchorage devices with templates for installing signs.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of metal finishes beyond normal weathering.
  - 2. Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.

#### 2.2 PLAQUES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Advance Corporation; Braille-Tac Division.

2. A. R. K. Ramos.
3. Gemini Incorporated.
4. Matthews International Corporation; Bronze Division.
5. Metal Arts; Div. of L&H Mfg. Co.
6. Mills Manufacturing Company.
7. Nelson-Harkins Industries.
8. Southwell Company (The).

B. Cast Plaques: Provide castings free of pits, scale, sand holes, and other defects, as follows:

1. Plaque Material: Aluminum.
2. Background Texture: Manufacturer's standard pebble texture.
3. Border Style: Square, polished.
4. Mounting: Concealed studs, noncorroding for substrates encountered.

### 2.3 DIMENSIONAL CHARACTERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ACE Sign Systems, Inc.
2. Advance Corporation; Braille-Tac Division.
3. A. R. K. Ramos.
4. ASI-Modulex, Inc.
5. Bunting Graphics, Inc.
6. Charleston Industries, Inc.
7. Gemini Incorporated.
8. Grimco, Inc.
9. Innerface Sign Systems, Inc.
10. Metal Arts; Div. of L&H Mfg. Co.
11. Mills Manufacturing Company.
12. Mohawk Sign Systems.
13. Nelson-Harkins Industries.
14. Signature Signs, Incorporated.
15. Southwell Company (The).

B. Cast Characters: Produce characters with smooth flat faces, sharp corners, and precisely formed lines and profiles, free of pits, scale, sand holes, and other defects. Cast lugs into back of characters and tap to receive threaded mounting studs. Alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated. Comply with the following requirements.

1. Character Material: Aluminum.
2. Thickness: As indicated.
3. Color(s): As selected by Architect from manufacturer's full range.
4. Mounting: Concealed studs, noncorroding for substrates encountered.

C. Provide 12 inch high characters for "OCEAN AVENUE ELEMENTARY SCHOOL."

### 2.4 ACCESSORIES

A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

## 2.5 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
  - 1. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

## 2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: Manufacturer's standard Class 1 clear anodic coating, 0.018 mm or thicker, over a satin (directionally textured) mechanical finish, complying with AAMA 611.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that items, including anchor inserts, are sized and located to accommodate signs.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
  - 1. Projected Mounting: Mount characters at projection distance from wall surface indicated.
- B. Cast-Metal Plaques: Mount plaques using standard fastening methods to comply with manufacturer's written instructions for type of wall surface indicated.
  - 1. Concealed Mounting: Mount plaques by inserting threaded studs into tapped lugs on back of plaque. Set in predrilled holes filled with quick-setting cement.

3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 101400

## SECTION 102113 - TOILET COMPARTMENTS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes:
  - 1. Solid-polymer toilet compartments configured as toilet enclosures and urinal screens.
- B. Related Sections include the following:
  - 1. Division 06 Section "Rough Carpentry" for blocking.
  - 2. Division 10 "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. LEED Submittals:
  - 1. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
  - 2. Credit MR 5.1: Product Data indicating location of material manufacturer for regionally manufactured materials.
    - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Show locations of cutouts for compartment-mounted toilet accessories.
- D. Samples for Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.
- E. Maintenance Data: For toilet compartments to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" for toilet compartments designated as accessible.

#### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without field measurements. Coordinate wall, floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221.
- B. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- C. Stainless-Steel Castings: ASTM A 743/A 743M.

#### 2.2 SOLID-POLYMER UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Accurate Partitions Corporation.
  - 2. Bradley Corporation; Mills Partitions.
  - 3. Columbia; by PSiSC, PolyLife 15000 Series.
  - 4. General Partitions Mfg. Corp.
  - 5. Global Steel Products Corp.
  - 6. Santana Products, Inc.
- B. Toilet-Enclosure Style: Overhead braced.
- C. Urinal-Screen Style: Wall hung.

- D. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
  - 1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
  - 2. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum or stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
  - 3. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range.
- E. Pilaster Shoes: Manufacturer's standard design; stainless steel.
- F. Brackets (Fittings):
  - 1. Full-Height (Continuous) Type: Manufacturer's standard design; extruded aluminum.
  - 2. Provide filler to match bracket for flush mounting over gypsum and ceramic tile condition.
- G. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.

### 2.3 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
  - 1. Material: Stainless steel.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

### 2.4 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Doors: Unless otherwise indicated, provide 24-inch- wide in-swinging doors for standard toilet compartments and 36-inch- wide out-swinging doors with a minimum 32-inch- wide clear opening for compartments indicated to be accessible to people with disabilities.
  - 1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
  - 2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.



3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with full length bracket on each side of panel.
  1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch.
    - b. Panels and Walls: 1 inch.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Wall-Hung Urinal Screens: Attach full length bracket on each side of panel to suit supporting structure. Set units level and plumb and to resist lateral impact.

#### 3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

## SECTION 102226 - OPERABLE PARTITIONS

## 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. Manually operated, acoustical panel partitions.

- B. Related Sections include the following:

- 1. Division 05 Section "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
  - 2. Division 09 Section "Gypsum Board" for sound barrier construction above the ceiling at track.
  - 3. Divisions 26 and 27 Sections for electrical service and connections for motor operators, controls, and limit switches; and for system disconnect switches.

## 1.3 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."
- B. NIC: Noise Isolation Class.
- C. NRC: Noise Reduction Coefficient.
- D. STC: Sound Transmission Class.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design operable panel partitions, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Seismic Performance: Operable panel partitions shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - 1. The term "withstand" means "the panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."
- C. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:

1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
2. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C 423, and rated for not less than the NRC indicated.
3. Acoustical Performance Requirements: Installed operable panel partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E 336, determined by ASTM E 413, and rated for 10 dB less than STC value indicated.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittal:
  1. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
  2. Credit MR 5.1: Product Data indicating location of material manufacturer for regionally manufactured materials.
    - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  1. For installed products indicated to comply with design loads, include structural analysis data for attachments, signed and sealed by the qualified professional engineer responsible for their preparation.
  2. Indicate storage and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
  3. Wiring Diagrams: For power, signal, and control wiring.
- D. Samples for Selection: For each type of exposed material, finish, covering, or facing indicated.
  1. Include similar Samples of accessories involving color selection.
- E. Delegated-Design Submittal: For operable panel partitions indicated to comply with performance requirements, including analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation.
  1. Design Calculations: Calculate requirements for seismic restraints.
- F. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.
- G. Seismic Qualification Certificates: For operable panel partitions, accessories, and components, from manufacturer.
  1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- H. Product Certificates: For each type of operable panel partition, from manufacturer.
- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each operable panel partition.
- J. Field quality-control reports.
- K. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
  2. Seals, hardware, track, carriers, and other operating components.
  3. Electric operator.
- L. Warranty: Sample of special warranty.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- C. Testing Agency Qualifications: Qualified according to Division 01 Section "Quality Requirements" for testing indicated.
- D. Fire-Test-Response Characteristics: Provide panels with finishes meeting one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265.
- E. 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.
- F. Preinstallation Conference: Conduct conference at Project site.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

## 1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of operable panel partition openings by field measurements before fabrication.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Faulty operation of operable panel partitions.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal wear.
  - 2. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Steel Frame: Steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
- B. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
- C. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B 221 for extrusions; manufacturer's standard strengths and thicknesses for type of use.
  - 1. Frame Reinforcement: Manufacturer's standard steel or aluminum.
- D. Gypsum Board: ASTM C 36/C 36M.
- E. Particleboard: ANSI A208.1, made with binder containing no urea formaldehyde.

## 2.2 OPERABLE ACOUSTICAL PANELS - TYPE 1

- A. Operable Acoustical Panels: Operable acoustical panel partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Hufcor: 631 Series.
  - b. Modernfold, Inc.; a DORMA Group Company: Acousti-Seal 931.
- B. Panel Operation: Manually operated, individual panels.
- C. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
1. Panel Width: Standard widths.
- E. STC: Not less than 50.
- F. NRC: Not less than 0.50.
- G. Panel Weight: 10 lb/sq. ft. maximum.
- H. Panel Thickness: Not less than 3 inches.
- I. Panel Closure:
1. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal.
  2. Final Closure: Flexible, resilient PVC, bulb-shaped acoustical seal.
- J. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
1. Hinges: Manufacturer's standard.

## 2.3 SEALS

- A. General: Provide types of seals indicated that produce operable panel partitions complying with acoustical performance requirements and the following:
1. Manufacturer's standard seals.
  2. Seals made from materials and in profiles that minimize sound leakage.
  3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.
- B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seal.
- C. Horizontal Top Seals:
1. Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track.

- D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
  - 1. Mechanically Operated for Acoustical Panels: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than 1-1/2 inches between retracted seal and floor finish.

## 2.4 FINISH FACING

- A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
  - 1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with no gaps or overlaps. Horizontal seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
  - 2. Match facing pattern 72 inches above finished floor.
  - 3. Color/Pattern: As selected by Architect from manufacturer's full range.
- B. High-Pressure Decorative Laminate: NEMA LD 3, Horizontal grade.
- C. Paint: Manufacturer's standard factory-painted finish.
  - 1. Color: As selected by Architect.
- D. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:
  - 1. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper required to comply with performance requirements; and with manufacturer's standard mill finish.
- E. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

## 2.5 SUSPENSION SYSTEMS

- A. Suspension Tracks: Steel or aluminum with adjustable steel hanger rods for overhead support, designed for type of operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
  - 1. Panel Guide: Aluminum; finished with factory-applied, decorative, protective finish.
  - 2. Head Closure Trim (Type 2 Panels): As required for acoustical performance; with factory-applied, decorative, protective finish.
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

1. Multidirectional Carriers: Capable of negotiating 90-degree L, T, and X intersections without track switches.
- C. Track Intersections, Switches, and Accessories: As required for type of operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.
1. L Intersections: Allowing panels to change 90 degrees in direction of travel.
  2. T Intersections: Allowing panels to pass through or change 90 degrees to another direction of travel.
  3. Center carrier stop.
- D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.
- E. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.
- B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed.
- C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

#### 3.3 ADJUSTING

- A. Adjust operable panel partitions to operate smoothly, without warping or binding. Lubricate hardware, electric operator, and other moving parts.
- B. Adjust pass doors to operate smoothly and easily, without binding or warping. Check and readjust operating hardware. Confirm that latches and locks engage accurately and securely without forcing or binding.



3.4 CLEANING

- A. Clean soiled surfaces of operable panel partitions to remove dust, loose fibers, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 102226

## SECTION 102600-WALL AND DOOR PROTECTION

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Corner guards.
  - 2. Impact-resistant wall coverings.
- B. Related Sections include the following:
  - 1. Division 08 Section "Door Hardware" for metal armor, kick, mop, and push plates.

## 1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall-protection unit.
- B. Shop Drawings: For each impact-resistant wall-protection unit showing locations and extent. Include sections, details, and attachments to other work.
  - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Selection: For each type of impact-resistant wall-protection unit indicated.
- D. Maintenance Data: For each impact-resistant wall-protection unit to include in maintenance manuals.
  - 1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.
- E. Warranty: Special warranty specified in this Section.

## 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain impact-resistant wall-protection units through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall-protection units and are based on the specific system indicated. Refer to Division 01 Section "Quality Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Fire-Test-Response Characteristics: Provide impact-resistant, plastic wall-protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store impact-resistant wall-protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
  2. Keep plastic sheet material out of direct sunlight.
  3. Store plastic wall-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
    - a. Store corner-guard covers in a vertical position.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install impact-resistant wall-protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F for not less than 72 hours before beginning installation and for the remainder of the construction period.
- B. Field Measurements: Verify actual locations of walls, columns, and other construction contiguous with impact-resistant wall-protection units by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall-protection units that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Deterioration of plastic and other materials beyond normal use.
  2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 MATERIALS

- A. Extruded Rigid Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout; thickness as indicated.
1. Impact Resistance: Minimum 25.4 ft-lbf/in. of notch when tested according to ASTM D 256, Test Method A.
  2. Chemical and Stain Resistance: Tested according to ASTM D 543.
  3. Self-extinguishing when tested according to ASTM D 635.
  4. Flame-Spread Index: 25 or less.
  5. Smoke-Developed Index: 450 or less.
- B. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated but with not less than strength and durability properties specified in ASTM B 221 for Alloy 6063-T5.
- C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

## 2.3 CORNER GUARDS (CG-1)

- A. Surface-Mounted, Resilient, Plastic Corner Guards: Assembly consisting of snap-on plastic cover installed over continuous retainer; including mounting hardware; fabricated with 90-degree turn to match wall condition.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. IPC Door and Wall Protection Systems; Division of InPro Corporation.
    - b. C/S Group; Model SM - 20AE.
  2. Cover: Extruded rigid plastic, Acrovyn 3000 PVC free, minimum 0.078-inch wall thickness; as follows:
    - a. Profile: Nominal 2-inch- long leg and 1/4-inch corner radius.
    - b. Height: 4 feet.
    - c. Color and Texture: As selected by Architect from manufacturer's full range.
  3. Retainer: Minimum 0.060-inch- thick, one-piece, extruded aluminum.
  4. Retainer Clips: Manufacturer's standard impact-absorbing clips.
  5. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

## 2.4 IMPACT-RESISTANT WALL COVERINGS (IWP and Rub Rails)

- A. Impact-Resistant Sheet Wall Covering: Fabricated from plastic sheet wall-covering material.
  - 1. Manufacturer: Subject to compliance with requirements, provide products by the following:
    - a. Construction Specialties, Inc.: Acrovyn Wall Covering.
  - 2. Size: As indicated.
  - 3. Sheet Thickness: 0.040 inch.
  - 4. Color and Texture: As indicated on the Finish Schedule.
  - 5. Height: As indicated.
  - 6. Trim and Joint Moldings: Extruded rigid plastic that matches sheet wall covering color.
  - 7. Mounting: Adhesive.
  - 8. Rub rails as shown on drawings to be one continuous sheet. (not butt joints).

## 2.5 FABRICATION

- A. Fabricate impact-resistant wall-protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

## 2.6 METAL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Remove tool and die marks and stretch lines or blend into finish.
  - 2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
2. For impact-resistant wall-protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

### 3.3 INSTALLATION

- A. General: Install impact-resistant wall-protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
  1. Install impact-resistant wall-protection units in locations and at mounting heights indicated on Drawings or, if not indicated, at heights indicated on the drawings.
  2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
    - a. Provide anchoring devices to withstand imposed loads.
    - b. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches.

### 3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

## SECTION 102813 - TOILET AND BATH ACCESSORIES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:

- 1. Toilet accessories.
- 2. Custodial accessories.
- 3. Childcare accessories.

- B. Owner-Furnished Material:

- 1. Toilet Tissue Dispenser.
- 2. Paper Towel Dispenser.
- 3. Soap Dispenser.
- 4. Sanitary Napkin Vendor.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:

- 1. Construction details and dimensions.
- 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- 3. Material and finish descriptions.
- 4. Features that will be included for Project.
- 5. Manufacturer's warranty.

- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

- 1. Identify locations using room designations indicated on Drawings.

- C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

## 1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

## 1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

## 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: 15 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- D. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

### 2.2 TOILET ACCESSORIES

- A. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
  - 1. A & J Washroom Accessories, Inc.
  - 2. American Specialties, Inc.
  - 3. Bradley Corporation.
  - 4. General Accessory Manufacturing Co. (GAMCO).
- B. Grab Bars (TBA-2a, 2b, 3a, 3b, 13):
  - 1. Basis-of-Design Product: Bobrick 6806 Series
  - 2. Mounting: Flanges with concealed fasteners.
  - 3. Material: Stainless steel, 0.05 inch thick.



- a. Finish: Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area.
  4. Outside Diameter: 1-1/2 inches.
  5. Configuration and Length: As indicated on Drawings.
- C. Mirror Unit (TBA-4):
1. Basis-of-Design Product: Bobrick B-290 2436.
  2. Frame: Stainless-steel channel.
    - a. Corners: Welded, ground and polished.
  3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
    - a. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
- D. Mirror Unit (TBA-5):
1. Basis-of-Design Product: Bobrick B-290.
  2. Frame: Stainless-steel channel.
    - a. Corners: Welded, ground and polished.
  3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
    - a. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
  4. Size: As indicated on Drawings.
- E. Waste Receptacle (TBA-8):
1. Basis-of-Design Product: Bobrick B-3644.
  2. Mounting: Semirecessed.
  3. Minimum Capacity: 12 gallon.
  4. Material and Finish: Stainless steel, No. 4 finish (satin).
  5. Liner: Reusable vinyl liner.
  6. Lockset: Tumbler type for waste-receptacle.
- F. Coat/Robe Hook (TBA-12):
1. Basis-of-Design Product: Bobrick B-7671
  2. Description: Single-prong unit.
  3. Material and Finish: Stainless steel, No. 7 finish (polished).
- G. Folding Shower Seat (TBA-14): Where this designation is indicated, provide heavy-duty hinged seat designed to fold up against wall when not in use with stainless-steel support braces, hinges, frame, and fasteners; of all-welded construction; and complying with the following:
1. Products: Available products include the following:
    - a. Bobrick No. B-518.
  2. Configuration: L-shaped seat, designed for wheelchair access.

3. Seat Material: Foam-padded, white vinyl seat.
- H. Shower Curtain and Rod (TBA-15): Where this designation is indicated, provide stainless-steel shower curtain rod with 3-inch stainless-steel flanges designed for exposed fasteners, in length required for shower opening indicated, and complying with the following:
1. Rod Product: Available products include the following:
    - a. Bobrick No. B-6047.
  2. Extra Heavy-Duty Rod: 1-1/4-inch OD; fabricated from nominal 0.05-inch- thick stainless steel.
  3. Curtain Product: Available products include the following:
    - a. Bobrick No. 204-2.
  4. Vinyl Shower Curtain: Minimum 0.006-inch- thick, opaque, matte vinyl with hemmed edges and corrosion-resistant grommets at minimum 6 inches o.c. through top hem.
    - a. Size: Minimum 6 inches wider than opening by 72 inches high.
    - b. Color: White.
  5. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.
- I. Sanitary-Napkin Disposal Unit (TBA-16):
1. Basis-of-Design Product: Bobrick No. B-254.
  2. Mounting: Surface mounted.
  3. Door or Cover: Self-closing, disposal-opening cover.
  4. Receptacle: Removable.
  5. Material and Finish: Stainless steel, No. 4 finish (satin).

## 2.3 CUSTODIAL ACCESSORIES

- A. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
1. A & J Washroom Accessories, Inc.
  2. American Specialties, Inc.
  3. Bradley Corporation.
  4. General Accessory Manufacturing Co. (GAMCO).
- B. Mop and Broom Holder (TBA-11):
1. Basis-of-Design Product: Bobrick B-239
  2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
  3. Length: 36 inches.
  4. Hooks: Three.
  5. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
  6. Material and Finish: Stainless steel, No. 4 finish (satin).
    - a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.

## 2.4 CHILDCARE ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Koala Kare Products; a division of Bobrick Washroom Equipment, Inc.
- B. Diaper-Changing Station (TBA-10):
  - 1. Basis-of-Design Product: Horizontal Baby Changing Station, KB100.
  - 2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
    - a. Engineered to support a minimum of 400-lb static load when opened.
  - 3. Mounting: Surface mounted, with unit projecting not more than 4 inches from wall when closed.
  - 4. Operation: By pneumatic shock-absorbing mechanism.
  - 5. Material and Finish: HDPE with plastic-laminate insert in color selected by Architect.
  - 6. Liner Dispenser: Built in.
- C. Shower Stretcher (TBA-17):
  - 1. Basis-of-Design Product: Linido, LI2403.190.
  - 2. Description: Hinged shower stretcher for showering a prone person, while the carer stands in an ergonomically helpful position.
    - a. Length: 74.4 inches.
  - 3. Mounting: Wall mounted, with unit projecting not more than 4 inches from wall when closed.
  - 4. Material and Finish: High quality epoxy coating, Blue color.

## 2.5 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## 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, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102813

## SECTION 104413 - FIRE EXTINGUISHER CABINETS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Fire protection cabinets for the following:
    - a. Portable fire extinguishers.
- B. Related Sections:
  - 1. Division 10 Section "Fire Extinguishers."

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
  - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
  - 2. Show location of knockouts for hose valves.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.
- D. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

## 1.4 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

## 1.5 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

- B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.
- C. Coordinate sizes and locations of fire protection cabinets with wall depths.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
  - 1. Sheet: ASTM B 209.
  - 2. Extruded Shapes: ASTM B 221.
- B. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

### 2.2 FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. J.L. Industries, Inc.
    - b. Larsen's Manufacturing Company.
    - c. Potter-Roemer; Div. of Smith Industries, Inc.
  - 2. Basis-of-Design Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following.
    - a. Semi-Recessed Units: Larsen's: Architectural Series 2409-R4.
    - b. Surface-mounted Units: Larsen's: Architectural Series 2409-SM.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Enameled steel sheet.
  - 1. Shelf: Same metal and finish as cabinet.
- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
  - 1. Rolled-Edge Trim: 3-1/2-inch backbend depth.
- E. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim. Provide where indicated on the drawings.

- F. Cabinet Trim Material: Enameled steel sheet.
- G. Door Material: Enameled steel sheet.
- H. Door Style: Vertical duo panel with frame.
- I. Door Glazing: Manufacturer's standard, as follows:
  - 1. Acrylic Sheet Color: Clear transparent acrylic sheet.
    - a. Thickness: 3 mm.
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
  - 1. Provide projecting door pull and friction latch.
  - 2. Provide manufacturer's standard hinge permitting door to open 180 degrees.
- K. Finishes:
  - 1. Manufacturer's standard baked-enamel paint for the following:
    - a. Exterior of cabinet, door, and trim except for those surfaces indicated to receive another finish.
    - b. Interior of cabinet and door.

### 2.3 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
  - 1. Weld joints and grind smooth.
  - 2. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
  - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
  - 2. Fabricate door frames of one-piece construction with edges flanged.
  - 3. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

### 2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.

- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.5 STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for hose and cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

### 3.3 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
  - 1. Fire Protection Cabinets: 54 inches above finished floor to top of cabinet.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
  - 1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.

### 3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.



- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

## SECTION 104416 - FIRE EXTINGUISHERS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Sections:
  - 1. Division 10 Section "Fire Extinguisher Cabinets."

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.
- C. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.
- D. Warranty: Sample of special warranty.

## 1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
  - 1. Provide fire extinguishers approved, listed, and labeled by FMG.

## 1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Failure of hydrostatic test according to NFPA 10.
    - b. Faulty operation of valves or release levers.
  2. Warranty Period: Six years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Amerex Corporation.
    - b. Ansul Incorporated; Tyco International Ltd.
    - c. Badger Fire Protection; a Kidde company.
    - d. Buckeye Fire Equipment Company.
    - e. J. L. Industries, Inc.; a division of Activar Construction Products Group.
    - f. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
    - g. Larsen's Manufacturing Company.
    - h. Potter Roemer LLC.
  2. Valves: Manufacturer's standard.
  3. Handles and Levers: Manufacturer's standard.
  4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- B. Wet-Chemical Type: UL-rated 2-A:1-B:C:K, 2.5-gal. nominal capacity, with potassium carbonate-based chemical in stainless-steel container; with pressure-indicating gage. Provide in Kitchen area.
- C. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

## 2.2 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Amerex Corporation.

- b. Ansul Incorporated; Tyco International Ltd.
- c. Badger Fire Protection; a Kidde company.
- d. Buckeye Fire Equipment Company.
- e. Fire End & Croker Corporation.
- f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
- g. Larsen's Manufacturing Company.
- h. Potter Roemer LLC.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
  - 1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

## SECTION 105126 - PLASTIC LOCKERS

## 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 solid plastic lockers.
- B. Related Sections include the following:
  - 1. Division 06 Section "Rough Carpentry" for furring, blocking, and shims required for installing metal lockers and concealed within other construction before metal locker installation.

## 1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of plastic locker.
- B. LEED Submittal:
  - 1. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
- C. Shop Drawings: Submit shop drawings showing locker plan layout, numbering plan, profiles, and product components, including anchorage, accessories and finish colors.
- D. Sample for Selection: Submit one sample, 4 x 4 inch in size, illustrating finish and color.
- E. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

## 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plastic lockers and accessories through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of plastic lockers and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Surface-Burning Characteristics: Units to comply with NFPA testing classifications meeting a minimum of a Class C rating.
- D. Regulatory Requirements: Where plastic lockers are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
1. Provide not less than 1 shelf located no higher than 48 inches above the floor for forward reach.
  2. Provide 1 shelf located at bottom of locker no lower than 15 inches above the floor for forward reach.
  3. Provide hardware that does not require tight grasping, pinching, or twisting of the wrist, and that operates with a force of not more than 5 lbf.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Do not deliver plastic lockers until spaces to receive them are clean, dry, and ready for metal locker installation.
  - B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
  - C. Store lockers indoors, protected from weather conditions and construction activities.
- 1.6 PROJECT CONDITIONS
- A. Field Measurements: Verify the following by field measurements before fabrication and indicate measurements on Shop Drawings:
    1. Concealed framing, blocking, and reinforcements that support plastic lockers before they are enclosed.
    2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish recessed opening dimensions and proceed with fabricating plastic lockers without field measurements. Coordinate wall and floor construction to ensure that actual recessed opening dimensions correspond to established dimensions.
- 1.7 COORDINATION
- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that plastic lockers can be supported and installed as indicated.
- 1.8 WARRANTY
- A. Special Warranty: Provide manufacturer's twenty year warranty against rust, delamination or breakage of plastic components.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for plastic lockers is based on LenoxLocker lockers by The Miles Company, a subsidiary of Bradley Corporation. Subject to compliance with requirements, provide the named product or an approved substitution.

## 2.2 MANUFACTURED UNITS

- A. Model LENOXLOCKER lockers, sizes as indicated in the schedule. Constructed with recycled plastic.

## 2.3 COMPONENTS

- A. Recycled Content: Provide material with at least 30 percent post-industrial recycled HDPE plastic.
- B. Locker material: Sides, backs, shelves, tops, bottoms, doors, door frames and continuous latch constructed from high-density polyethylene (HDPE).
  - 1. Sides, shelves, tops, bottoms and backs fabricated from 3/8 inch HDPE.
  - 2. Doors, door frames and continuous latch fabricated from 1/2 inch HDPE.
  - 3. Slope tops fabricated from 1/2 inch HDPE sheets, and 1 inch HDPE back plates.
  - 4. Bases fabricated from 1 inch HDPE.
  - 5. End panels fabricated from 3/8 inch HDPE.
  - 6. Flat tops fabricated from 1/2 inch HDPE.
- C. Door hinge: Continuous piano hinge fabricated from 16 gauge type 304 stainless steel.

## 2.4 HARDWARE AND ACCESSORIES

- A. Provide two plastic double coat hook for each opening in one and two tier lockers.
- B. Provide one number plate for each opening.
- C. Provide screws, anchors and angle brackets for locker base installation.
- D. Provide hardware for attaching bench top to pedestals and anchoring pedestals to floor.

## 2.5 LOCKER BENCHES

- A. Model LENOXBENCH bench lockers, 60 inch long x 12 inch deep.
- B. Pedestal bench: Top fabricated from 1-1/2 inch thick HDPE, pedestals 18-1/2 inch black anodized aluminum with welded aluminum flanges.
- C. Locker bench top: 1 inch thick HDPE.

## 2.6 FABRICATION

- A. Locker box fabricated from a single sheet of HDPE with corners fused together. Weld frame and shelves to box assembly.
- B. Attach hinge to door and frame with vandal-resistant double threaded stainless steel screws.
- C. Continuous latch securely attached to the entire length of the door with stainless steel screws, providing a full length latching mechanism capable of accepting several lock types.
- D. Locking device: Hasp.
- E. Provide openings at top and bottom of each door for ventilation.
- F. Base: 4 inch high.
- G. End panels: Flat top as indicated.
- H. Factory finish:
  - 1. Tops, bottoms, side walls, backs, shelves, and continuous latch, smooth white commercial grade.
  - 2. Door, and door frames, slightly textured matte finish, allow for 4 colors selected from manufacturer's standard.
  - 3. Hinge powdercoated to match door and frame.
  - 4. Base color: Allow for 4 colors selected from manufacturer's standard.
  - 5. End panel color: Allow for 4 colors selected from manufacturer's standard.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims.
  - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion, using concealed fasteners.
  - 2. Anchor single rows of plastic lockers to walls near top of lockers and to floor.
  - 3. Anchor back-to-back plastic lockers to floor.
- B. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.



1. Attach hooks with at least two fasteners.
2. Identification Plates: Identify plastic lockers with numeric identification.
  - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
3. Attach filler panels with concealed fasteners. Locate fillers panels as required.
4. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed plastic lockers.

### 3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.
- B. Protect plastic lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit plastic locker use during construction.
- C. Touch up marred finishes, or replace plastic lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by plastic locker manufacturer.

### 3.4 PLASTIC LOCKER SCHEDULE

- A. Kitchen Lockers: Where plastic lockers of this designation are indicated, provide products complying with the following:
  1. Locker Arrangement: Double tier.
  2. Size: 15 inches wide by 15 inches deep by 36 inches high each.
  3. Backs: Solid.
  4. Sides: Solid.
  5. Door Style: Vented.
  6. Shelf: Solid.
  7. Hinges: Heavy-duty hinge.
  8. Handles/Latches: Hasp style.
  9. Locks: By others.
  10. Accessories:
    - a. Hooks.
    - b. Number Plates.
    - c. Filler panels.
  11. Colors: As selected by Architect from manufacturer's full range.
- B. Corridor Lockers: Where plastic lockers of this designation are indicated, provide products complying with the following:
  1. Locker Arrangement: Single tier.
  2. Size: 15 inches wide by 15 inches deep by 36 inches high; ADA locker, single-tier.
  3. Backs: Solid.
  4. Sides: Solid.
  5. Door Style: Louvered vents.
  6. Shelf: Solid.
  7. Hinges: Heavy-duty hinge.
  8. Handles/Latches: Hasp style.

9. Locks: By others.
  10. Accessories:
    - a. Hooks.
    - b. Number Plates.
    - c. Filler panels.
    - d. Finished End Panels.
  11. Colors: As selected by Architect from manufacturer's full range.
- C. Athletic Lockers: Where plastic lockers of this designation are indicated, provide products complying with the following:
1. Locker Arrangement: Double tier.
  2. Size: 12 inches wide by 15 inches deep by 48 inches high
  3. Backs: Solid.
  4. Sides: Solid.
  5. Door Style: Louvered vents.
  6. Shelf: Solid.
  7. Hinges: Heavy-duty hinge.
  8. Handles/Latches: Hasp style.
  9. Locks: By others.
  10. Accessories:
    - a. Hooks.
    - b. Number Plates.
    - c. Filler panels.
    - d. Finished End Panels.
  11. Colors: As selected by Architect from manufacturer's full range.

END OF SECTION 105126

## SECTION 113100 - RESIDENTIAL APPLIANCES

## 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. Cooking appliances.
  - 2. Refrigeration appliances.
  - 3. Cleaning appliances.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, dimensions, furnished accessories, and finishes for each appliance.
- B. LEED Submittal:
  - 1. Product Data for Credit EA 1.4: For appliances, documentation indicating that products are ENERGY STAR rated.
- C. Product Schedule: For appliances. Use same designations indicated on Drawings.
- D. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.
- E. Warranties: Sample of special warranties.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with the following:
  - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Regulatory Requirements, Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)".

1. Operable Parts: Provide controls with forward reach no higher than 48 inches above the floor, horizontal front reach no more than 25 inches, horizontal side reach no more than 24 inches, and that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Range or Cooktop: Provide knee clearance for forward approach of 27 inches high, 30 inches wide, and 11 inches horizontally; toe space clearance of 9 inches high and 17 inches horizontally; with insulated underside of cooktop to prevent burns, shocks, or abrasions. Provide top surface 34 inches above the floor, with controls that do not require reaching across burners.
3. Refrigerator/Freezer: Provide 50 percent of freezer space within 54 inches of the floor.

D. AHAM Standards: Provide appliances that comply with the following AHAM standards:

1. Electric Ranges: AHAM ER-1.
2. Clothes Dryers: AHAM HLD-1.
3. Household Refrigerators: AHAM HRF-1.

E. Energy Ratings: Provide residential appliances that carry labels indicating energy-cost analysis (estimated annual operating costs) and efficiency information as required by the FTC Appliance Labeling Rule.

1. Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

## 1.5 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.

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

## PART 2 - PRODUCTS

### 2.1 WALL OVENS

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

1. Amana; a division of Whirlpool Corporation.
2. General Electric Company (GE).
3. KitchenAid; a division of Whirlpool Corporation.
4. Maytag; a division of Whirlpool Corporation.
5. Whirlpool Corporation.

B. Electric Wall Oven: One-oven unit.

1. Basis-of-Design Product: Bosch 500 Series, No. HBL5036AUC.
2. Mounting: Built-in cabinet.
3. Operation: Baking and self-cleaning.
4. Broiler: Located in top of oven.
5. Oven Door: Counterbalanced, removable, with observation window and full-width handle.
6. Electric Power Rating:

- a. Oven: 3000 W.

- b. Broiler: 3500 W.
- 7. Electric Power Supply: 240 V, 60 Hz, 1 phase, 30 A.
- 8. Controls: Manufacturer's standard controls and timer display.
- 9. Material: Stainless steel.

## 2.2 MICROWAVE OVENS

- A. Microwave Oven: Freestanding microwave oven, listed by UL, and complying with the following requirements:
  - 1. Products: Available products include the following:
    - a. General Electric: Model JE1040WY
  - 2. Type: Freestanding, 1.0 CU. FT. capacity microwave oven with 1000 W.
    - a. Controls: Solid-state, electronic, touch type.
    - b. Clock Type: Digital.
  - 3. Standard features include the following:
    - a. Automatic defrost.
    - b. Child lockout feature.
    - c. Cooking complete reminder.
  - 4. Optional features include the following:
    - a. Turntable.

## 2.3 REFRIGERATION APPLIANCES

- A. Refrigerator/Freezer:
  - 1. Basis-of-Design Product: GE model GSS22IBTWW.
  - 2. Type: Freestanding, frost-free, side-by-side refrigerator/freezer.
  - 3. Storage Capacity:
    - a. Fresh Food Compartment Volume: 14.81 cu. ft.
    - b. Freezer Volume: 7.04 cu. ft.
    - c. Shelf Area: 3 adjustable glass shelves, 21.9 sq. ft..
  - 4. Refrigerator Features:
    - a. Compartment Storage: Vegetable crisper Meat compartment.
    - b. Door Storage: Dairy compartment.
    - c. Interior light in each compartment.
  - 5. Freezer Features:
    - a. Ice storage bins.
    - b. Automatic icemaker and storage bin.
    - c. Circulator fan.

6. Energy Consumption: Measured and certified by AHAM HRF-1 at not more than 635 kWh/year under average conditions for a refrigerated volume of 19.9.0 cu. ft..
  7. Temperature Controls: Separate temperature controls for each compartment.
  8. Appliance Color: White.
- B. Refrigerator/Freezer: One-door refrigerator with inside freezer compartment and complying with AHAM HRF-1.
1. Basis-of-Design Product: General Electric model GMR06AAPWW.
  2. Type: Undercounter.
  3. Dimensions:
    - a. Width: 24 inches.
    - b. Depth: 24 inches.
    - c. Height: 34-1/2 inches.
  4. Storage Capacity:
    - a. Refrigeration Compartment Volume: 5.51 cu. ft..
    - b. Freezer Volume: 0.49 cu. ft..
    - c. Shelf Area: Two adjustable wire shelves, 8.80 sq. ft..
  5. General Features:
    - a. Door Configuration: Overlay.
  6. Refrigerator Features:
    - a. Door Storage: Modular compartments.
    - b. Interior light.
  7. Freezer Features: One freezer compartment configured as pull-out drawer(s).
    - a. Manual defrost.
  8. Appliance Color/Finish: White.

## 2.4 CLEANING APPLIANCES

- A. Clothes Washer:
1. Basis-of-Design Product: GE model WSSH300GWW.
  2. Type: Freestanding, front loading, operable at water pressures from 15 to 120 psi.
  3. Basket: Perforated stainless steel with 3.5-cu. ft. capacity.
  4. Controls: Adjustable, rotary-dial, turn-to-start-type controls for water-fill levels, wash/rinse water temperatures, and variable-speed and fabric selectors.
    - a. Wash Cycles: 10 wash cycles including regular, delicate, and permanent press.
    - b. Wash Temperatures: Four settings.
    - c. Speed Combinations: Four.
  5. Finish: Porcelain enamel on top and lid. Baked enamel on front and sides.
  6. Color: White.
  7. Standard features include the following:

- a. Unbalanced load compensator.
- b. Inlet Hoses: Minimum length 60 inches.
- c. Drain Hoses: Minimum length 48 inches.
- d. Self-leveling legs.
- e. Spin-cycle safety switch.
- f. Extra rinse option.

B. Clothes Dryer:

1. Basis-of-Design Product: GE model DSXH43EFWW.
2. Type: Freestanding, electric.
3. Drum: Perforated porcelain enamel with 5.7-cu. ft. capacity.
4. Controls: Adjustable, rotary-dial, turn-to-start-type controls for drying cycle, temperatures, and fabric selectors.
5. Power Requirement, Electric Dryer: 208-240 V, 30 A, 5600 W.
6. Finish: Porcelain enamel on top and lid; baked enamel on front and sides.
7. Color: White.
8. Standard features include the following:
  - a. Removable lint filter.
  - b. Electronic temperature and moisture level sensor control.
  - c. End-of-cycle signal.
  - d. Interior drum light.
  - e. Self-leveling legs.

C. Clothes Washer/Dryer Combination: Complying with ASSE 1007.

1. Basis-of-Design Product: General Electric Model No. WSM2700HWW.
2. Type: Freestanding washer/dryer unit with dual-drum design and electric dryer; washer is top loading.
3. Dimensions:
  - a. Width: 27 inches.
  - b. Depth: 30-13/16 inches.
  - c. Height: 75-1/2 inches.
4. Washer and Dryer Drums: Manufacturer's standard.
  - a. Washer-Drum Capacity: 2.7 cu. ft..
  - b. Dryer-Drum Capacity: 5.7 cu. ft..
5. Washer Controls: Rotary-dial controls for water-fill levels, wash/rinse water temperatures, and variable-speeds and fabric selectors.
6. Dryer Controls: Rotary-dial controls for drying cycle, temperatures, and fabric selectors.
  - a. Wash Cycles: Nine wash cycles including regular, delicate, and permanent press.
  - b. Wash Temperatures: Three settings.
  - c. Speed Combinations: One.
7. Electric Washer/Dryer Power: 120/240 V, 60 Hz, 1 phase, 30 A.
8. Motor: Manufacturer's standard with built-in overload protector.
9. Washing Features:
  - a. Self-cleaning lint filter.
  - b. Unbalanced-load compensator.
  - c. Inlet Hoses: Minimum length 60 inches.
  - d. Drain Hoses: Minimum length 48 inches.

- e. Self-leveling legs.
  - f. Automatic dispenser for bleach.
  - g. Spin-cycle safety switch.
10. Drying Features:
- a. Removable lint filter.
  - b. Electronic temperature and moisture level sensor control.
  - c. End-of-cycle signal.
11. Water-Efficient Clothes Washer: Provide clothes washer with modified energy factor greater than or equal to 2.0 and water factor less than 5.5.
12. Appliance Finish: Porcelain enamel on top and lid; baked enamel on front and sides.
- a. Color: White.
- D. ADA-Compliant Dishwasher: Where this designation is indicated, provide dishwashers listed by UL and complying with the following:
- 1. Products: Available products include the following:
    - a. General Electric: Model GLDA690MWW
  - 2. Type: Automatic, built-in, under-the-counter dishwasher; sized to replace 24-inch base cabinet; operable at water pressures from 15 to 120 psi.
  - 3. Tub and Door Liner: Stainless steel.
    - a. Detergent Dispenser: Sealed detergent and automatic rinsing-aid dispensers in door liner.
  - 4. Rack System: Nylon-coated sliding dish racks with removable silverware basket.
  - 5. Operation: Six wash cycles with hot-air and heat-off drying cycle options.
  - 6. Controls: Solid-state, electronic, press-to-start type.
  - 7. Front Panel Finish: Manufacturers standard, trimless panels.
    - a. Color: White.
  - 8. Standard features include the following:
    - a. Full-extension, vinyl-coated, upper and lower dish racks.
    - b. Removable silverware basket.
    - c. Sound-absorbing exterior insulation blanket around tub and back.
    - d. Soft food disposer.
    - e. Self-cleaning food-filter system.
  - 9. Optional features include the following:
    - a. Delay start feature.

## 2.5 GENERAL FINISH REQUIREMENTS

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



- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- C. Utilities: See Divisions 26 for electrical requirements.

#### 3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

#### 3.4 SCHEDULE

- A. Administration Kitchenette: Under-counter refrigerator and microwave oven.
- B. Book Room 203A: Under-counter refrigerator and microwave oven.
- C. Clinic: Under-counter refrigerator.
- D. Staff Lounge: Full size refrigerator, dish washer and microwave oven.
- E. FLS: Wall oven.
- F. FLS Toilet Room: Standard washer and dryer.
- G. Recycling Room: Stackable washer/dryer combo.

END OF SECTION 113100

## SECTION 114000 - FOODSERVICE EQUIPMENT

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A The general conditions of division 1 including supplementary conditions and general requirements apply to the work specified in this section.

## 1.2 RELATED WORK, NOT INCLUDED BY FOODSERVICE EQUIPMENT CONTRACTOR

- A Plumbing: Refer to division 220000 including
  - 1 Rough-in
  - 2 Piping for supply and waste lines.
  - 3 Traps, grease traps, line strainers, tail pieces, valves, stops, shutoffs, and miscellaneous fittings required for complete installation.
  - 4 Final connection, including mounting of foodservice equipment contractor supplied faucets and waste assemblies.
- B Ventilation: Refer to division 230000 including
  - 1 Final utility connections.
  - 2 Exhaust Hoods and Fans to be received and installed by HVAC contractor.
- C Electrical: Refer to division 260000 including
  - 1 Rough-in.
  - 2 Conduit, wiring, line and disconnect switches, safety cutoffs and fittings, control panels, fuses, boxes and fittings required for complete installation.
  - 3 Final connections, including mounting and wiring of starters and switches furnished as part of the foodservice equipment (unless otherwise indicated on the drawing).

## 1.3 WORK INCLUDED IN THIS SECTION

- A Furnish point of connections and install all foodservice equipment here-in, including that which is reasonably inferred, with all related items necessary to complete work shown on contract drawings and/or required by these specifications.
- B Electrical Work:
  - 1 Interwiring of foodservice equipment between components within equipment, such as heating elements, switches, thermostats, motors, etc., complete with junction box or disconnect switch as is applicable, ready for final connection.
  - 2 Voltages shall be as indicated on contract drawings. Any difference in electrical characteristics at job site from those shown on contract documents must be submitted to the architect for consideration prior to ordering equipment.
- C Plumbing Work:
  - 1 Furnish all equipment with faucets and sink waste assemblies as specified in this section.

## 1.4 SUBMITTALS

- A Submit shop drawings as required by general conditions.
- B Shop drawings and bound brochures covering manufactured or "buy-out" items covering all work and equipment included in this contract shall be submitted to owner as soon as possible after award of contract. After approval, foodservice contractor shall furnish to architect sets of shop drawings and brochures, corrected as required by virtue of review comments, for distribution to various interested trades on project. All cost of reproduction shall be part of contract.
- C Provide fully dimensioned rough-in plans at 1/4" scale, showing all required mechanical, electrical, ventilation, water waste, and refrigeration services for equipment and rough-in locations for same. Rough-in locations shown shall make allowances for traps, switches, etc., thereby not requiring interpretation or adjustment on the part of other contractors. Drawings shall indicate dimensions for floor depressions, wall openings, etc., for equipment.
- D Foodservice equipment contractor shall visit site to verify all rough-in and sleeve locations prior to installation of finished floors, and shall cooperate with other contractors involved in proper location of same.
- E Fully dimensioned and detailed shop drawings of custom-fabricated equipment items shall be submitted, drawn at 3/4" and 1/2" scale for plans, elevations, and sections, respectively. Drawings shall show all details of construction, installation, and relation to adjoining and related work where cutting or close fitting is required. Drawings shall show all reinforcements, anchorage, and other work required for complete installation of all fixtures.
- F Do not begin fabrication of custom-manufactured equipment until approvals of shop drawings have been received, and until field measurements have been taken by foodservice equipment contractor, where such measurements are necessary to assure proper conformance with intent of contract drawings and specifications.
- G Make field measurements, giving due consideration to any architectural, mechanical, or structural discrepancies that may occur during construction of building. No extra compensation will be allowed for any difference between actual measurements secured at job site and dimensions shown on drawings. Field measurements shall be submitted to architect for consideration before proceeding with fabrication of equipment.
- H Submit illustrated brochures for manufactured or "buy-out" equipment items complete with illustrations, specifications, line drawings, rough-in requirements, and list of accessories or other specified additional requirements. Brochures shall be bound and shall include data on all equipment that is to be provided, arranged in numerical sequence that conforms to item numbers of specifications. Omission of data does not reduce obligation to provide items as specified.

#### 1.5 SUBSTITUTIONS – STANDARDS

- A Proposals shall be based on brands, materials, and forms of construction specified unless products of other manufacturers that conform to requirements of plan and specifications are approved in writing by owner as equal to that as specified.
- B Any equipment offered for approval as "equal" to equipment specified must conform to space limitations of layout. Cost of any deviation from kind or location of mechanical service provided in layout due to furnishing of an approved equal will be the responsibility of foodservice contractor, at no extra cost to owner.

- C If no equals are approved in writing by owner, the brands and materials specified must be furnished, and no other substitution will be permitted subsequent to award of contract except by specific change order issued by owner.

#### 1.6 DRAWINGS

- A Drawings that constitute part of contract documents indicate general arrangement of piping and location of equipment. Should it be necessary to deviate from arrangement indicated in order to meet structural conditions, make such deviations without expense to owner.
- B Specifications and drawings are reasonably exact, but their extreme accuracy is not guaranteed. Drawings and specifications are for assistance and guidance of contractor, and exact locations, distances, and levels shall be governed by the building.

#### 1.7 MANUFACTURER'S DIRECTIONS

- A Follow manufacturer's directions in all cases where manufacturers of articles used in this contract furnish directions or prints covering points not shown on drawings or specifications.

#### 1.8 QUALITY ASSURANCE

- A It is required that all custom-fabricated equipment such as tables, sinks, countertops, etc., be manufactured by a foodservice equipment fabricator who has a plant, personnel and engineering required. Such manufacturer shall be subject to approval of architect. All work in the above category shall be manufactured by one manufacturer, and shall be of uniform design and finish.
- B Manufacturer of this equipment must be able to show that he is now and for the past five years has been engaged in manufacture or distribution of equipment, as required under this contract.
- C Manufacturer of this equipment herein specified shall be a recognized distributor for items of equipment specified herein that are of other manufacture than his own.
- D Only manufacturers who can meet the foregoing qualifications will be acceptable.

#### 1.9 INDUSTRY STANDARDS

- A Electrically operated and/or heated equipment, fabricated or otherwise, shall conform to latest standards of National Electric Manufacturers Association and of Underwriters Laboratories, Inc., and shall bear the U.L. label.
- B Items of foodservice equipment furnished shall conform to standards of National Sanitation Foundation, Ann Arbor, Michigan, and shall bear the N.S.F seal.
- C Foodservice equipment shall be installed in accordance with N.S.F. standards.
- D Work and material shall be in compliance with requirements of applicable codes, ordinances, and regulations, including but not limited to those of the National Fire Protection Association, State Fire Marshal, State Board of Health, Local Health Codes, etc.
- E Rulings and interpretations of enforcing agencies shall be considered part of regulations.

## 1.10 EQUIPMENT HANDLING AND STORAGE

- A Deliver equipment to site, properly crated and protected, and store in safe place. Protect from damage until time for installation.

## 1.11 GUARANTEE

- A Equipment furnished under this contract shall be guaranteed for a period of one year from the date of final acceptance thereof against defective materials, designs, and workmanship. Upon receipt of notice of failure, any part or parts shall be replaced promptly, at the expense of foodservice equipment contractor. Until replacement equipment is installed, owner shall have full use of defective equipment. Warranty shall include labor, all parts, and driving time to and from job site.
- B This guarantee shall include installation, start-up, and one-year free service for all self-contained refrigeration equipment furnished under this contract, with evidence of manufacturer's one-year guarantee on entire cabinet, and additional four-year warranty on sealed compressor motor assembly.

## 1.12 OPERATING AND MAINTENANCE MANUALS

- A After completion of installation, foodservice equipment contractor shall present to owner three sets of all operating and maintenance manuals, covering all mechanically operated equipment furnished under this contract, each set being bound in loose leaf binder having durable cover. Include in each binder a list of names, addresses, and telephone numbers of service agencies authorized to make necessary repairs and/or adjustments of equipment furnished under this contract.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURED EQUIPMENT

- A Except as may be specified otherwise under individual item specifications in "Equipment Schedule," all items of standard manufactured equipment furnished shall be complete in accord with manufacturer's standard specifications for specific unit or model called for, including finishes, components, attachments, appurtenances, etc., except as follows:
- B Substitutions for manufactured equipment specified will be accorded consideration under terms set forth in "Substitutions-Standards."

## 2.2 FABRICATED EQUIPMENT

- A Work shall be done in an approved workmanlike manner, to complete satisfaction of owner.
- B Stainless steel shall be U.S. standard gauges as called for, 18-8, Type 304, not over .012% maximum carbon, No. 4 finish.
- C Galvanized iron shall be Armco or equal. Framework of galvanized iron shall be welded construction, having welds smooth, and where galvanizing has been burned off, touched up with high-grade aluminum bronze.
- D Legs and crossrails shall be continuously welded, unless otherwise noted, and ground smooth.

- E Bottom of legs at floor shall be fitted with sanitary stainless steel bullet-type foot, with no less than 1-1/2" adjustment.
- F Legs shall be fastened to equipment as follows:
- 1 To sinks by means of closed gussets. Gussets shall be stainless steel, reinforced with bushings, having set screws for securing legs.
  - 2 To tables and drainboards with closed gussets which shall be welded to galvanized (when not exposed) or S/S (when exposed) hat channels, 14 gauge or heavier, exposed hat sections having closed ends. Bracing shall be underside of tops.
- G Closed gussets shall be 3" minimum diameter at top, welded to frame members or to sink bottom.
- H Sinks, unless otherwise specified, shall be furnished with lever-type waste outlets with connected overflows. Where exposed, furnish wastes chromium plated.
- I Rolls shall be 1 1/2" diameter, except as detailed to the contrary, with corners bullnosed, ground, and polished.
- J Seams and joints shall be shop-welded. Welds to be ground and polished to match original finish. Materials 18 gauge or heavier shall be welded.
- K Metal tops shall be one-piece welded construction, unless specified otherwise, reinforced on underside with galvanized hat channels welded in place. Cross bracing not to be more than 30" on center.
- L Drawers to be 18 gauge stainless steel channel-type housing and drawer cradle, both cradle and housing being reinforced and welded at corners, housing being secured to underside of tabletop, and both housing and cradle being sized for and fitted with 20" x 20" x 5" deep thermo plastic drawer insert having coved corners. Drawer insert shall be easily removable from cradle without tools or having to remove entire drawer.
- M Drawer fronts and doors: Except where single-pan construction is indicated, provide double-pan type, not less than 5/8" thick, with seams on inside face. Deaden sound by inserting mineral wool insulation between pans.
- N Hardware shall be solid materials and except where unexposed or specified to the contrary, of cast brass, chrome-plated. Identify all hardware with manufacturer's name and number so that broken or worn parts may be ordered and replaced.
- O Fabricate sink compartments with 3/4" coved vertical and horizontal corners. Multiple-compartment partitions to be double thickness, continuously welded where sheets join at top. Front of multiple-compartment sinks to be continuous on exterior. Bottoms to be creased to drain.
- P Ends of fixtures, splashbacks, shelves, etc., shall be finished flush to walls or adjoining fixtures.
- Q Dishtables, drainboards, splashbacks, and turn-up edges shall have radius bends in all horizontal and vertical corners, coved at intersections.
- R Rounded and coved corners or radius bends shall be 1/2" radius or longer.
- S Undersides of tops to be coated with sound deadening tacky tape. Sinks are to be coated with Component Hardware sound deadening compound.
- T Shelves are to be turned up 2" on back edge. Turn other edges down 1 1/2" to form open channels. Reinforce shelf units to support 40 lbs. per square foot loading, plus 100% impact loading.

- U Casework at fabricator's option, unless otherwise indicated. Provide either box-type framing or open-channel-type (complying with N.S.F. requirements in either case).
- V Enclosures: Except as indicated, provide each unit of casework (base, wall overhead, and free-standing) with a complete-enclosure metal cabinet, including fronts, backs, tops, bottoms, and sides.
- W Metal components, unless specified or noted otherwise, to be the following gauges:
- |    |                            |          |                 |
|----|----------------------------|----------|-----------------|
| 1  | Tabletops                  | 14 gauge | Stainless steel |
| 2  | Wall shelves               | 16 gauge | "               |
| 3  | Undershelves               | 16 gauge | "               |
| 4  | Drawer fronts (single pan) | 16 gauge | "               |
| 5  | Enclosed cabinet bases     | 18 gauge | "               |
| 6  | Sinks and drainboards      | 14 gauge | "               |
| 7  | Exhaust hoods              | 18 gauge | "               |
| 8  | Legs (1-5/8" dia.)         | 16 gauge | "               |
| 9  | Cross bracing (1" dia.)    | 16 gauge | "               |
| 10 | Doors (outer pan)          | 18 gauge | "               |
| 11 | Doors (inner pan)          | 20 gauge | "               |

### 2.3 HEATING EQUIPMENT

- A Wherever heating equipment or thermostat control for such equipment is specified, it shall be complete, and of the materials, size, and rating specified within equipment items or details. All such equipment shall be designed and installed to be easily cleaned or to be easily removed for cleaning.
- B Electrical appliances or heating element circuits of 120 volts shall not exceed 1650 watts, unless specifically shown to the contrary.

### 2.4 SWITCHES AND CONTROLS

- A All internal wiring for fabricated equipment items, including all electrical devices, wiring, controls, switches, etc., built into or forming an integral part of these items shall be furnished and installed by foodservice equipment contractor in his factory or building site with all items complete to junction box for final connection to building lines by electrical contractor.
- B Provide standard 3-prong plugs to fit "U" slot grounding-type receptacles, for all equipment items powered by plugging into 110-120 volts, single-phase AC.

### 2.5 CONNECTION TERMINALS

- A All equipment shall be complete with connection terminals as standardized by equipment manufacture, except where specified otherwise.

### 2.6 LOCKS

- A Fit all doors for reach-in refrigerated compartments with locking-type latches.

### 2.7 LAMINATE PLASTICS

- A Wherever laminate plastic materials are specified, veneer all materials using urea base cement, waterproof, and heatproof. Rubber base adhesives are not acceptable. Apply materials directly over close-grained plywood face exposed surfaces and edges with 1/16" material, and corresponding back faces with 1/32" reject material. Place top sheet on and over finished edge.

### PART 3 - EXECUTION

#### 3.1 EXECUTION

- A Work under this contract and covered under this section of specification includes but not limited to:
  - 1 Cutting of holes and/or ferrules on equipment for piping, drains, electrical outlets, conduits, etc., as required to coordinate installation of kitchen and foodservice equipment work of the other contractors on project.
  - 2 Field checking of building and rough-in requirements, and submission of brochures and shop drawings, all as required herein before under "submittals."
  - 3 Repair of all damage to premises as result of this installation, and removal of all debris left by those engaged in this installation.
  - 4 Having all foodservice equipment fixtures completely cleaned and ready for operation when building is turned over to owner.

#### 3.2 INSTALLATION PROCEDURES

- A Foodservice equipment contractor shall make arrangements for receiving his custom-fabricated and "buy-out" equipment and shall make delivery into building as requisitioned by his installation superintendent. He shall not consign any of his equipment to owner or to any other contractor unless he has written acceptance from them and has made satisfactory arrangements for the payment of all freight and handling charges.
- B Foodservice equipment contractor shall deliver all of his custom-fabricated and "buy-out" equipment temporarily in its final location, permitting trades to make necessary arrangements for connection of service lines.
- C This contractor shall coordinate his work and cooperate with other trades working at site toward the orderly progress of the project.
- D Owner or owner's agent shall have access at all times to plant or shop in which custom-fabricated equipment is being manufactured, from time contract is let until equipment is shipped, in order that progress of work can be checked, as well as any technical problems that may arise in coordination of equipment with building. Any approval given at this point of manufacturer shall be tentative, subject to final inspection and test after complete installation.
- E Foodservice equipment contractor shall assist owner, and/or owner's agent, in making any desired tests during or prior to final inspection of equipment; he shall remove immediately any work or equipment rejected by owner, and/or owner's agent, replacing the same with work conforming to contract requirements.
- F This contractor shall keep premises free from accumulation of his waste material and rubbish, and at completion of his work shall remove his rubbish and implements, leaving areas of his workroom clean.
- G This contractor shall provide and maintain coverings or other protection for finished surfaces and other parts of his equipment subject to damage during and after erection. After removal of protective



coverings, all field joints shall be ground and polished, and entire work shall be thoroughly cleaned and polished.

### 3.3 TRIMMING AND SEALING EQUIPMENT

- A Seal completely spaces between all units to walls, ceilings, floors, and adjoining (not portable) units with enclosed bodies against entrances of food particles or vermin by means of trim strips, welding, soldering, or commercial joint material best suited to nature of equipment and adjoining surface material.
- B Close ends of all hollow sections.
- C Equipment butting against walls, ceilings, floor surfaces, and corners to fit tightly against same; backsplashes or risers that fit against wall to be neatly scribed and sealed with a N.S.F. approved clear silicone sealant, wiping excess out of joint to fillet radius. Where required to prevent shifting of equipment and breaking wall seal, anchor item to floor or wall.

### 3.4 TESTING AND DEMONSTRATION OF EQUIPMENT

- A After complete installation, all items of equipment furnished under this contract shall be thoroughly tested to ensure proper and safe operation.
- B Foodservice equipment contractor shall arrange to have all manufactured, mechanically operated equipment furnished under this contract demonstrated by manufacturer's representatives. These representatives to instruct owner's designated personnel in use, care, and maintenance of all items of equipment after same are in working order. Demonstration and instruction shall be held on dates designated by owner.
- C Foodservice equipment contractor shall provide a competent service representative to be present when installation is put into operation.

### 3.5 ITEMIZED SPECIFICATIONS

Item #: 1

Description: Mop Sink

Manufacturer: Advance/Tabco

Model #: 9-OP-20

SIS #: T037

Quantity: 1

Alternate Manufacturer: Universal Stainless, Select Stainless

Specification:

Features: Floor mounted unit eliminates the need of lifting heavy containers. No-Drip die formed recessed V-edge on three sides with a tile edge furnished on the rear. Sink bowl is seamless and DEEP DRAWN designed. DEEP DRAWN bowls having large liberal radii with a minimum dimension of 3" and rectangular in design for increased capacity.

Construction: All TIG welded. Welded areas blended to match adjacent surfaces and to a satin finish.

Mechanical: Supply is 1/2" hot and cold. Drain is cast brass with 2" IPS male threads. Stainless steel drain body is designed for a lead caulk joint to a 2" drain pipe.

Material: Entire unit is 16 gauge type 304 series stainless steel.

Accessories: Unit shall be equipped with (1) one model # K-240 service faucet, (1) one model # K-242 mop hanger, and (1) one model # K-244 hose and hanger.

Unit to be modified with a 12" high flat splash on all sides that are against walls.

Item #: 2

Description: Shelving Unit

Manufacturer: ISS

Model #: Gold Bond

SIS #: T037

Quantity: 7

Alternate Manufacturer: Amco, Metro, Hodges

Specification:

Shelving shall be of the type manufactured by International Storage Systems and known as ISS Shelving. A shelving unit shall be able to be assembled without tools. When the plastic Sure Lock corner inserts is secured to the round post and shelf lowered into place the shelving unit shall be free from sway or rocking without the need of additional bracing. The one piece molded plastic Sure Lock shall be of a hinged design with 2 internal ridges that fit secure into 2 of the post grooves. The ribbed exterior of the Sure Lock grips the inside of the corner ring to securely lock the shelf to the post. Corner rings shall be 1-15/16 inch in height formed to create a precision tapered opening that works in combination with the post and ribbed Sure Lock to form a stable, heavy load bearing shelving unit.

The shelving design shall incorporate multiple trusses running lengthwise in addition to a truss on each end of the shelf. This design shall provide for a rigid framework to minimize deflection under load and to allow for uniform weight loading of up to 1250 lbs. per shelf. Each shelf shall have a minimum of 4 trusses running the length of the shelf. The outer trusses shall be of a vertical design. The intermediate and end trusses shall be a serpentine design.

The shelving shall be fabricated of C1006 Plating Quality Carbon Steel or of Stainless Steel. The shelf deck shall have a raised edge on all four sides a minimum of .200" high. Running the length of the shelf shall be 2 die formed marine edges, and on the ends the top rod of the truss shall be raised above the shelf deck. Each shelf shall have ribs of 9 ga. wire on 1" centers running front to back. Perpendicular to these 9 ga. ribs there are additional support rods of 4 ga. wire running the length of the shelf.

Posts shall be of 1" round tubing with .065" (16 gauge) thick walls made of plating quality cold rolled steel having grooves spaced 1" apart with embossed numbers. each post shall have a plastic top cap and leveling foot.

Each unit shall consist of four (4) 74-3/4 inch posts with casters, two locking, and four (4) shelves sized as per plan. All with the "Gold Bond" finish.

Item #: 3

Description: Work Table with Pass-Thru

Manufacturer: Fabricated

Model #: Custom

SIS #: T037

Quantity: 1

Alternate Manufacturer: Advance/Tabco, Universal Stainless, Select Stainless

Specification:

Unit to be size and shape as shown on plan and in detail. 8'-0" long, by 30" wide (plus pass-thru) by 36" high to work surface. Unit to feature 14 gauge stainless steel top with square channel edges on all four sides, polished to a #4 satin finish with #8 highlighting. Understructure to be rigidly braced with stainless steel channeling. Top shall be fitted with (1) one 16" x 18" x 12" deep sink bowl with 2" lever operated

waste assembly with built-in overflow. Top to have provisions for (1) one deck mounted faucet. Faucet to be T&S Brass model B-0221-CC, with 12" swing nozzle and "CC" male inlets. Table to have stainless steel undershelf notched and welded to stainless steel legs. Area below sink to remain open with stainless steel cross bracing notched and welded to legs. Unit to have stainless steel gussets and adjustable bullet feet. Unit to be complete with (1) one premium double pan drawer assembly. Unit top to be modified so that it protrudes 1" through wall opening with 2" turn down and 1" return to wall at 90° with ends closed.

Unit shall be complete with one stainless steel window frame. Sized and shape as shown on plan and in detail. Constructed of 16 gauge type 304 stainless steel and polished to a #4 satin finish. Unit to be telescoping (split) type frame construction with 2" flush return on kitchen side and 2" return at 90 degrees with ½" return to wall on cafeteria side with all ends closed.

Item #: 4

Description: Range, 4-Burner

Manufacturer: Vulcan

Model #: 24L

SIS #: T037

Quantity: 1

Alternate Manufacturer: Jade, Garland, Southbend

Specification:

24" wide gas restaurant range, Vulcan-Hart Model No. 24L. Stainless steel front, sides, back riser, high shelf and 6" adjustable legs. Red control panel with oversized easy grip knobs. Four 26,000 BTU/hr. cast top burners with lift-off burner heads. Individual pilot for each burner. 12" x 12" cast top grates with aeration bowl. Top grates and burner heads finished with matte black porcelain. Full width pull-out crumb tray under burners. 35,000 BTU/hr. space saver oven measures 20-1/4" w x 22" d x 14-1/2"h. Thermostat adjusts from 150 to 500 degree F. One oven rack and two rack positions. 3/4" rear gas connection and gas pressure regulator. Total input 139,000 BTU/hr.

Exterior dimensions: 24" w x 31-3/4" d x 59-1/2"h on 6" adjustable legs. 36-1/2" working height.

AGA and CGA design certified and NSF listed.

Unit to come complete with (1) one set of four casters, two locking, (1) one ¾" NPT gas shut-off valve, and (1) Dormont model 1675 KITCF2S48PS, ¾" x 48" long flexible gas hose kit with quick disconnect, restraining device and posi-set.

Unit to have factory authorized start-up, which shall include but not limited to calibration, lighting of pilots, start-up and testing. Start-up shall be scheduled and coordinated with job site mechanical and electrical contractors so that issues can be resolved at time of start-up. Start-up should only be scheduled after all mechanical systems to the foodservice equipment have been cleaned, tested, and confirmed operational.

Item #: 5

Description: Combi-Oven

Manufacturer: Rational

Model #: SCC-102G

SIS #: T037

Quantity: 2

Alternate Manufacturer: None

Specification:

Description: Unit for the automatic cooking (Self-Cooking Control Mode) of roasts, grills, poultry, fish, baked dishes, side dishes, and for automatic Finishing. Combi-Steamer (Combi-Steamer Mode) for most cooking methods employed in the catering trade, with optional use of steam and hot air, separately, sequentially or combined

Features: High-performance fresh steam generator. Microprocessor-controlled cooking process. Clear control panel with pictograms. Self-explanatory operation concept with easy-to-read clear text displays which can be read from any angle, Help Function, touch screen, press buttons and central dial with Push Function to confirm entries. Individual programming of at least 350 cooking programs with up to 12 steps. Rack monitoring with individual time programming of each rack in non-stop loading. Adjustable foreign languages display. Free time selection from 0-24 hours. Sensor-controlled cabinet humidity, actual humidity in cabinet can be adjusted and requested on the control panel. Demand-related energy supply by means of modulating, low-noise high-performance blower burner system. Core temperature probe with 6 measuring points and automatic correction if inserted incorrectly. Positioning aid for core temperature probe. Function Delta-T cooking. Automatic cleaning system independent of mains pressure, with 6 cleaning stages, unsupervised cleaning even overnight. Seamless hygienic cooking cabinet with rounded corners. Automatic, active rinsing and drainage of steam generator by pump. Lime scale level of steam generator automatically sensed, automatic indication of when descaling is necessary, lime scale level displayed at any time. Menu-guided descaling program. Preselected starting time adjustable for time and date. Temperature unit adjustable in °C or °F. Service Diagnostic System with automatic service notices display. Airflow optimized cooking cabinet. Integral, maintenance-free grease extraction system with no additional grease filter. Safety temperature limiter for cabinet and steam generator. Halogen cooking cabinet lighting from shock-proof CERAN glass. Cool down function for fast cabinet fan cooling. Automatic vapor quenching. Humidifying function can be programmed with humidity values from 85°F-500°F for Dry Heat and Combination. 5 air speeds programmable. Integral fan impeller brake. Half power setting. Operating and warning displays. Rear-ventilated double glass doors, hinged inside pane for easy cleaning. Door handle with right/left and slam function. Door locking positions. Proximity door contact switch. Drip collector and door drip pan with continuous discharge to unit drain. Press-fit cabinet seal. Lengthwise loading for accessories. Hinging rack with additional rail for grease drip container, rail distance 2 5/8", hinging racks swivel for easy cleaning. 5 grids 20 x 18" x 26". Rail distance 2 1/2". Maximum rack height 5 1/4 ft. when original stand used. U-shaped rack rails with notched recesses for easy loading. All-round heat insulation. Swivel air baffle with quick-release locks. Hinged control panel allows front servicing and inspection. Integral hand shower with infinitely variable regulation, automatic retracting system and integral water shut-off function. Separate solenoid valves for normal and soft water. Height-adjustable feet. HACCP data memory and output via integral USB interface. Material inside and out CrNi steel CNS 304.

Options and Accessories: (per unit)

- (1) Ethernet interface
- (1) Mobile Stand model UG II (Art. No. 60.30.118)
- (6) CombiFry 1/1 GN (frying baskets) (Art. No. 6019.1250)
- (1) Cleaner Tabs, pack of 100 (Art. No. 56.00.210)
- (1) Rinse Aid-Tabs, pack of 100 (Art. No. 56.00.211)

Each unit to be complete with (1) one Dormont model 1675 KITCF2S48PS, 3/4" x 48" long flexible gas hose kit with quick disconnect, restraining device and posi-set.

Unit to have factory authorized start-up, which shall include but not limited to calibration, lighting of pilots, start-up and testing. Start-up shall be scheduled and coordinated with job site mechanical and electrical contractors so that issues can be resolved at time of start-up. Start-up should only be scheduled after all mechanical systems to the foodservice equipment have been cleaned, tested, and confirmed operational.

Item #: 6

Description: Refrigerator, 2-Section, Roll-In

Manufacturer: Victory

Model #: RIA-2D-S7

SIS #: T037

Quantity: 1

Alternate Manufacturer: Continental, Traulsen

Specification:

Unit to be model RIA-2D-S7 Roll-In Refrigerator as manufactured by Victory with stainless steel fronts and doors. Aluminum sides and interior.

Cabinet: Each Victory cabinet is internally supported, braced and assembled into a single rigid unit. The cabinet front and doors are constructed of heavy gauge polished stainless steel to maintain an attractive appearance after years of heavy use. Foamed-in-place polyurethane insulation throughout the cabinet and doors ensures the ultimate in energy efficiency.

Doors: The self-closing doors are securely mounted on rugged cam-lift hinges, which have a lifetime guarantee. Each door has a heavy duty cylinder lock and self-adjusting magnetic gasket to prevent the cold air from escaping. Humidity control wires located around the door jamb prevent condensation from forming on the cabinet front and are concealed by a high impact, non-conductive thermal breaker strip. The interior door liner is constructed of durable ABS material, which resists denting and scratching and is easy to clean. Each safety grip handle is guaranteed for life. Removable ramps are provided on the bottom of each door opening.

Refrigeration System: All components of the self-contained refrigeration system are mounted on top of the cabinet. The air circulating fans and the forced convection-cooling coil are contained in an insulated housing separate from the product zone allowing for maximum food storage capacity. All condensate water is disposed of automatically by the energy efficient non-electric condensate evaporator, no plumbing is required.

Item #: 7

Description: Refrigerator, 1-Section, Roll-In

Manufacturer: Victory

Model #: RIA-1D-S7

SIS #: T037

Quantity: 1

Alternate Manufacturer: Continental, Traulsen

Specification:

Unit to be model RIA-1D-S7 Roll-In Refrigerator as manufactured by Victory with stainless steel fronts and doors. Aluminum sides and interior.

Cabinet: Each Victory cabinet is internally supported, braced and assembled into a single rigid unit. The cabinet front and doors are constructed of heavy gauge polished stainless steel to maintain an attractive appearance after years of heavy use. Foamed-in-place polyurethane insulation throughout the cabinet and doors ensures the ultimate in energy efficiency.

Doors: The self-closing doors are securely mounted on rugged cam-lift hinges, which have a lifetime guarantee. Each door has a heavy duty cylinder lock and self-adjusting magnetic gasket to prevent the cold air from escaping. Humidity control wires located around the door jamb prevent condensation from forming on the cabinet front and are concealed by a high impact, non-conductive thermal breaker strip. The interior door liner

is constructed of durable ABS material, which resists denting and scratching and is easy to clean. Each safety grip handle is guaranteed for life. Removable ramps are provided on the bottom of each door opening.

Refrigeration System: All components of the self-contained refrigeration system are mounted on top of the cabinet. The air circulating fans and the forced convection-cooling coil are contained in an insulated housing separate from the product zone allowing for maximum food storage capacity. All condensate water is disposed of automatically by the energy efficient non-electric condensate evaporator, no plumbing is required.

Item #: 8

Description: Freezer, 1-Section, Roll-In

Manufacturer: Victory

Model #: FIA-1D-S7

SIS #: T037

Quantity: 1

Alternate Manufacturer: Continental, Traulsen

Specification:

Unit to be model FIA-1D-S7 Roll-In Freezer as manufactured by Victory with stainless steel fronts and doors. Aluminum sides and interior.

Cabinet: Each Victory cabinet is internally supported, braced and assembled into a single rigid unit. The cabinet front and doors are constructed of heavy gauge polished stainless steel to maintain an attractive appearance after years of heavy use. Foamed-in-place polyurethane insulation throughout the cabinet and doors ensures the ultimate in energy efficiency.

Doors: The self-closing doors are securely mounted on rugged cam-lift hinges, which have a lifetime guarantee. Each door has a heavy duty cylinder lock and self-adjusting magnetic gasket to prevent the cold air from escaping. Humidity control wires located around the door jamb prevent condensation from forming on the cabinet front and are concealed by a high impact, non-conductive thermal breaker strip. The interior door liner is constructed of durable ABS material, which resists denting and scratching and is easy to clean. Each safety grip handle is guaranteed for life. Removable ramps are provided on the bottom of each door opening.

Refrigeration System: All components of the self-contained refrigeration system are mounted on top of the cabinet. The air circulating fans and the forced convection-cooling coil are contained in an insulated housing separate from the product zone allowing for maximum food storage capacity. All condensate water is disposed of automatically by the energy efficient non-electric condensate evaporator, no plumbing is required.

Item #: 9

Description: Sheet Pan Rack

Manufacturer: New Age

Model #: 4338

SIS #: T037

Quantity: 4

Alternate Manufacturer: None

Specification:

Unit to be model 4338 Universal Roll-In Rack as manufactured by New Age Industrial Corp., Inc. with the following features:

Material: High tensile extruded primary aluminum, Type 6063-T5 alloy. All heli-arc welded aluminum construction.

Angle Guides: Angle guides of 1 ½" x 3 ¼" x .100 thick extruded aluminum are fully welded to the uprights to accommodate 18" x 26" and/or 12" x 20" pans.

Uprights: Constructed of 1 ½" x 1 ¾" smooth "D" shaped aluminum tube. Cross braces of 1" x 1" are welded to the uprights with gussets fully welded in place to strengthen upright and brace attachments.

Base" Consists of 1 ¼" x 1 ½" aluminum tubing with pre-tapped caster plates welded inside.

Casters: Four 5" platform type swivel casters, 1-3/8" x 5" with non-marking wheels, are inset from the base perimeter.

Each unit to be modified with (2) two model C530 casters, and (2) two model C532 casters with brakes, and modified to be only 64" high overall with the 6" casters.

Item #: 10

Description: Therm & Hold Cabinet

Manufacturer: Winston

Model #: CAT522

SIS #: T037

Quantity: 2

Alternate Manufacturer: None

Specification:

Unit Shall be Winston CVap therm & hold cabinet, Model CAT522, for reheating and serving precooked foods. Utilizes Controlled Vapor Technology (U.S. Patent #5,495,690) as a method and apparatus for reheating and holding hot foods, consisting of an air heater and water heater to establish ideal water vapor content that is in relation with the moistness characteristics for the food.

Construction: Materials: To be commercial and institutional grade stainless steel to provide ease of cleaning and long service life with reasonable use and care. Rack supports: Adjustable, normally spaced 3.5" (89 mm), to receive 14 sheet pans or 28 steam table pans. Removable for easy cleaning. Doors: Field reversible hinges allow door lift off to facilitate cleaning. Magnetic door latch. Casters: 5" (127mm), includes 2 locking, 2 non-locking, heavy duty, non-marking. Insulation: Full-perimeter high-temp mineral fiber. Controller: Computerized processor control with eight preprogrammed retherm cycles which can be operator-adjusted to precise temperature, food texture, and time. Will automatically hold if required. Water fill: Optional use automatic water fill system includes a saddle valve and 1/4" (6mm) flexible tubing kit. Connection located at lower left back of cabinet. Low mineral potable water is recommended, otherwise use deionizer/demineralizer to minimize corrosive damage. Ventilation: Allow 2" (51mm)

ventilation clearance on sides, back, and top of appliance. Install with supplied legs or casters. Refer to use & care manual for specific installation instructions. Generally this appliance does not need to be installed under a mechanical ventilation system (vent hood). Check local health and fire codes for requirements specific to your location. Electrical: Supplied with 7' (213cm) (minimum) power cord, and plug. Load limit: 65 lbs. (29.25 kg) per rack.

Warranty: Limited 1 year warranty (excluding gaskets, lamps, hoses, power cords, glass panels, and evaporators). Warranty disclaimer for failure to clean. Ask for complete warranty disclosure.

Options and Accessories: One unit to be left hand hinged, One unit to be right hand hinged. Both unit to have the Transport option with bumper guard base, cord wrap and evaporator cover.

Item #: 11

Description: Spare Number

Manufacturer: None

Model #: None  
SIS #: T037  
Quantity: 0  
Alternate Manufacturer:

Specification:

Item #: 12  
Description: Spare Number  
Manufacturer: None  
Model #: None  
SIS #: T037  
Quantity: 0  
Alternate Manufacturer:

Specification:

Item #: 13  
Description: Spare Number  
Manufacturer: None  
Model #: None  
SIS #: T037  
Quantity: 0  
Alternate Manufacturer:

Specification:

Item #: 14  
Description: Hand Sink  
Manufacturer: Advance/Tabco  
Model #: 7-PS-91  
SIS #: T037  
Quantity: 1  
Alternate Manufacturer: Universal Stainless, Select Stainless

Specification:

Features: One piece Deep Drawn sink bowl design. "Hands Free" Electronic Faucet makes use of infrared technology to sense the user's presence and immediately turn on water supply that is pre-mixed to desired temp. All sink bowls have a large liberal radii with a minimum dimension of 2" and are rectangular in design for increased capacity.

Construction: All TIG welded. Welded areas blended to match adjacent surfaces and to a satin finish. Die formed Countertop Edge with a 3/8" No-Drip offset. One sheet of stainless steel is used. There are no welded seams other than corners.

Mechanical: Electronic faucet is 1/2" male IPS thread. K-175 Electronic gooseneck faucet is splash mounted and comes complete with sensor, 6V DL223A battery, spout, solenoids and all mounting hardware. K-6 stainless steel basket drain 1-1/2" IPS. Sink bowl is 10" x 14" x 5" Material: Heavy gauge type 304 series stainless steel. Electronic Faucet solid brass, chrome plated. Wall mounting bracket is stainless steel and of offset design. All fittings are brass / nickel plated unless otherwise indicated.

Unit to be complete with pedestal base, towel dispenser with hinged towel box and liquid soap dispenser.



Item #: 15

Description: Spare Number

Manufacturer: None

Model #: None

SIS #: T037

Quantity: 0

Alternate Manufacturer:

Specification:

Item #: 16

Description: Dishwasher, Undercounter

Manufacturer: Meiko

Model #: FV 40.2

SIS #: T037

Quantity: 1

Alternate Manufacturer: None

Specification:

Dishwasher shall be an NSF and UL approved Meiko FV 40.2 hot water sanitizing undercounter dishmachine. Unit shall be 208-230 Volt/60 Hz/ 1-Phase. Unit shall have a front mounted microcomputer controls, a 105 second total time cycle, and utilize 1.09 gallons of fresh rinse water per cycle. Dishmachine shall utilize a fresh water pumped rinse for constant pressure and temperature every cycle. Unit shall have integral wash tank soil removal system to maintain clean wash water and have built-in temperature safeguards to guarantee washing and rinsing at minimum required temperatures. Wash pump shall be equipped with a smooth start feature to eliminate chipped and broken dishware. Unit shall also incorporate features to stop operation and shut off water flow to the machine should leakage occur. Machine shall have variable time cycles for heavier than normal soil loads.

Unit to be complete with Detergent and Rinse Aid pumps.

Item #: 17

Description: Sink, 3-Compartment

Manufacturer: Fabricated

Model #: Custom

SIS #: T037

Quantity: 1

Alternate Manufacturer:

Specification:

Unit to be shape and size as shown on plan and in detail. Unit to feature 14 gauge stainless steel. All vertical and horizontal corners to be coved on a 3/4" radius, meeting in spherical sections. Polished to a #4 satin finish with #8 highlighting. Front of unit to be totally flush welded. Backsplash and left end splash to be coved 3/4" and up 10" high with 2" return to wall at 45° with ends closed. Unit to have a 180 degree raised rolled rim on front and right end. Drainboards to be 14 gauge stainless steel and shall be pitched and welded integral to unit. Sink partitions to be 5/8" thick 14 gauge stainless steel double wall construction. Understructure of unit to be 14 gauge triangular channeling welded to bottom. To include provisions for (2) three faucets. Bottom of sink die stamped with a 3-1/2" opening and depressed to accept a 2" lever operated waste with built-in overflow. Sink to rest on stainless steel legs, stainless steel gussets,

and stainless steel adjustable bullet feet. Stainless steel crossbracing shall be notched and welded to legs. Unit shall come complete with three (3) 2" lever operated waste assemblies with built-in overflows, one (2) T&S model B-0231-CC splash mounted faucet, one (1) T&S model B-0133 splash mounted pre-rinse spray with B-109 wall bracket. Provisions shall be made for Item # 18, Waste Reduction System below left hand drainboard, including disposer cone, control panel, vacuum breaker holes, disposer, and mini pulper. Provisions shall also be made to the installation of Item # 16, Dishwasher, Undercounter below right hand drainboard.

Each sink bowl to measure 20" x 28" x 14" deep. Overall length as per plan.

Item #: 18

Description: Waste Reduction System

Manufacturer: Insinkerator

Model #: WX-300

SIS #: T037

Quantity: 1

Alternate Manufacturer: None

Specification:

Unit to be model WX-300 Waste Xpress Food Waste Reduction System as manufactured by In-Sink-Erator. Unit to include Waste Xpress Unit, 3 HP Disposer, WX101 Electrical control panel, 18" Type A sink bowl assembly with two adjustable water nozzles, and includes removable splash baffle and stainless bowl cover. Syphon breaker, Solenoid valve, Flow control valve 10 Gallon round waste can, and 3" to 2" disposer outlet adapter.

Item #: 19

Description: Serving Counter, Heated Module

Manufacturer: Delfield

Model #: SPH-50E

SIS #: T037

Quantity: 1

Alternate Manufacturer: Galley

Specification:

Exterior: Exterior body is constructed of 18 gauge stainless steel side panels or 18 gauge galvanized reinforced laminated panels. 14 gauge galvanized bottom. All exterior side panels are reinforced with overlapping corners and are welded in place. All insert cutouts are reinforced with 14 gauge galvanized channel supports. Exterior top is constructed of 14 gauge stainless steel, welded, ground and polished into one integral unit. Top is fabricated with square exterior corners with fully hemmed nosing on operator and customer sides. Stainless steel fully retractable interlocks are installed on opposing corners and locks units into a complete serving system.

Interior: Heated pan is 10" deep one-piece constructed stainless steel tank. Louvered front and rear sides are for re-circulated forced air heating. The tank is separated from the top by a polycarbonate thermal break keeping surface temperatures below 90 degrees. Entire tank is fully insulated with foamed in place high-density polyurethane foam.

Heating System: Convected air type heating system with squirrel cage blower and on/off switch. Components include hi-limit protection circuit, (2) 900 watt fin style heating elements and a night switch. A stainless steel access panel is located in the bottom of the unit allowing complete access to the heating elements. The fan is accessible through the operator side of the control panel. Unit meets NSF 4 temperature requirements. Night switch is located on the operator side in the upper right corner behind a

spring-hinged cover. On/off switch and adjustable range thermostat is located on the operator side in a recessed panel with a hinged cover plate.

Lids: Lids are constructed of stainless steel and are insulated with polyurethane foam insulation. The lid thickness is ¾". Lid handle shall be black, recessed ABS. Lids are removable without the use of tools. Stainless steel lid locking bar is standard. Bar has locking handle at one end and mounts to clips, which are bolted to the top of the cabinet. The locking bar extends the length of the unit. Entire assembly can be removed during the serving period.

Electrical: Electrical connections shall be 120 volt, 60 hertz, single phase. Unit shall have a 9' long electrical cord and NEMA 5-30 plug. Cord is standard on the operator right side of the equipment. Double cord hook is located on the bottom of the unit.

Casters: Unit is mounted on 5" (12.7cm) diameter swivel polyurethane casters with non-marking tires and plate brakes. Casters are bolted directly to the 14 gauge bottom of the base. Overall height of the caster assembly is 6" (15.2cm)

Styling: Units are standard with 18 gauge stainless steel exterior sides. Laminate is an option available at no additional charge.

#### Options and Accessories:

Full length double tier merchandiser (Unheated)  
 Tray Slides, V-Style, 2-Required, Modified to be 10" wide.  
 (20) Twenty 2" Wire Baskets (13.25" x 20.5" x 2.5" deep)  
 (40) Forty 4" Wire Baskets (13.25" x 20.5" x 4.75" deep)  
 Stainless Steel Exterior Panels

Item #: 20

Description: Serving Counter, Cold Food

Manufacturer: Delfield

Model #: SCSC-60-B

SIS #: T037

Quantity: 1

Alternate Manufacturer: Galley

#### Specification:

Exterior Body is constructed of 18 gauge stainless steel side panels and 14 gauge galvanized bottom. All exterior side panels are reinforced with overlapping corners and are welded in place. All body cutouts are reinforced with 14 gauge galvanized channel supports.

Exterior Top shall be constructed of 14 gauge, type 304 stainless steel with No. 3 finish, welded, ground and polished into one integral unit. Top shall be fabricated with square exterior corners.

Refrigerated Cold Pan is 6" deep and constructed of 18 gauge stainless steel with 0.25" diameter coved corners. The cold pan is separated from the exterior top by a concealed breaker strip. Copper refrigeration tubing is attached to the sides and bottom of the cold pan and is fully insulated with foamed-in-place polyurethane insulation. Cold pan is equipped with a 1" I.P.S. drain and plumbed to a drain valve located at the bottom of the unit.

Refrigeration; Unit is refrigerated by a self-contained 115 volt, 60 Hertz, single phase hermetically sealed condensing unit with adjustable cold pan temperature control. Unit is wired with a 3-wire, grounded, maximum 10' 120 volt cord and plug. Unit has an on/off switch mounted on the exterior.

Casters; unit shall be mounted on 5" diameter swivel casters with non-marking polyolefin tires and plate brakes. Overall height of caster assembly shall be 6".

#### Options and Accessories:

12" wide stainless steel fold-down tray slides modified to be 10" wide. 2-required.

Line-up interlock device  
Double service flip-up sneeze guard  
Stainless Steel Exterior Panels  
Counter height to be modified to 30"-AFF.

Item #: 21

Description: Spare Number

Manufacturer: None

Model #: None

SIS #: T037

Quantity: 0

Alternate Manufacturer:

Specification:

Item #: 22

Description: Serving Counter, Cashier Stand

Manufacturer: Delfield

Model #: SCS-30

SIS #: T037

Quantity: 1

Alternate Manufacturer: Galley

Specification:

Exterior Body is constructed of 18 gauge stainless steel side panels and 14 gauge galvanized bottom. All exterior side panels are reinforced with overlapping corners and are welded in place. All body cutouts are reinforced with 14 gauge galvanized channel supports.

Interior Lining at the cashier's end is 18 gauge stainless steel, with a 1" diameter stainless steel foot rest at the bottom center. Unit shall have an 18" x 18" x 5" deep stainless steel cash drawer with lock and key.

Exterior Top shall be constructed of 14 gauge, type 304 stainless steel with No. 3 finish, welded, ground and polished into one integral unit. Top shall be fabricated with square exterior corners. A 2" ferruled hole is located at the rear of the top to allow cord access for the register.

Casters; unit shall be mounted on 5" diameter swivel casters with non-marking polyolefin tires and plate brakes. Overall height of caster assembly shall be 6".

Options and Accessories:

12" wide stainless steel fold-down tray slides modified to be 10" wide. 2-required.

120V/60Hz/1-phase, 15 amp convenience outlet with breaker.

Stainless Steel Exterior Panels

Counter height to be modified to 30"-AFF.

Item #: 23

Description: Serving Counter, Cashier Stand

Manufacturer: Delfield

Model #: SCS-30

SIS #: T037

Quantity: 1

Alternate Manufacturer: Galley

## Specification:

Exterior Body is constructed of 18 gauge stainless steel side panels and 14 gauge galvanized bottom. All exterior side panels are reinforced with overlapping corners and are welded in place. All body cutouts are reinforced with 14 gauge galvanized channel supports.

Interior Lining at the cashier's end is 18 gauge stainless steel, with a 1" diameter stainless steel foot rest at the bottom center. Unit shall have an 18" x 18" x 5" deep stainless steel cash drawer with lock and key.

Exterior Top shall be constructed of 14 gauge, type 304 stainless steel with No. 3 finish, welded, ground and polished into one integral unit. Top shall be fabricated with square exterior corners. A 2" ferruled hole is located at the rear of the top to allow cord access for the register.

Casters; unit shall be mounted on 5" diameter swivel casters with non-marking polyolefin tires and plate brakes. Overall height of caster assembly shall be 6".

## Options and Accessories:

12" wide stainless steel fold-down tray slides modified to be 10" wide.

Line-up interlock device.

120V/60Hz/1-phase, 15 amp convenience outlet with breaker.

Stainless Steel Exterior Panels

Counter height to be modified to 32"-AFF.

Daisy Chain electrical connections for Items 23 thru 26.

## Item #: 24

Description: Serving Counter, Cold Food

Manufacturer: Delfield

Model #: SCSC-50-B

SIS #: T037

Quantity: 1

Alternate Manufacturer: Galley

## Specification:

Exterior Body is constructed of 18 gauge stainless steel side panels and 14 gauge galvanized bottom. All exterior side panels are reinforced with overlapping corners and are welded in place. All body cutouts are reinforced with 14 gauge galvanized channel supports.

Exterior Top shall be constructed of 14 gauge, type 304 stainless steel with No. 3 finish, welded, ground and polished into one integral unit. Top shall be fabricated with square exterior corners.

Refrigerated Cold Pan is 6" deep and constructed of 18 gauge stainless steel with 0.25" diameter coved corners. The cold pan is separated from the exterior top by a concealed breaker strip. Copper refrigeration tubing is attached to the sides and bottom of the cold pan and is fully insulated with foamed-in-place polyurethane insulation. Cold pan is equipped with a 1" I.P.S. drain and plumbed to a drain valve located at the bottom of the unit.

Refrigeration; Unit is refrigerated by a self-contained 115 volt, 60 Hertz, single phase hermetically sealed condensing unit with adjustable cold pan temperature control. Unit is wired with a 3-wire, grounded, maximum 10' 120 volt cord and plug. Unit has an on/off switch mounted on the exterior.

Casters; unit shall be mounted on 5" diameter swivel casters with non-marking polyolefin tires and plate brakes. Overall height of caster assembly shall be 6".

## Options and Accessories:

12" wide stainless steel fold-down tray slides modified to be 10" wide.

10" wide stainless steel fold-down work shelf

Line-up interlock device

Single service flip-up sneeze guard  
Open understorage with shelf  
Stainless Steel Exterior Panels  
Counter height to be modified to 32"-AFF.  
Daisy Chain electrical connections for Items 23 thru 26.

Item #: 25

Description: Serving Counter, Flat Top  
Manufacturer: Delfield  
Model #: SC-28-NU  
SIS #: T037  
Quantity: 1  
Alternate Manufacturer: Galley

Specification:

Exterior Body is constructed of 18 gauge stainless steel side panels and 14 gauge galvanized bottom. All exterior side panels are reinforced with overlapping corners and are welded in place. All body cutouts are reinforced with 14 gauge galvanized channel supports.  
Exterior Top shall be constructed of 14 gauge, type 304 stainless steel with No. 3 finish, welded, ground and polished into one integral unit. Top shall be fabricated with square exterior corners.  
Casters; unit shall be mounted on 5" diameter swivel casters with non-marking polyolefin tires and plate brakes. Overall height of caster assembly shall be 6".

Options and Accessories:

12" wide stainless steel fold-down tray slides modified to be 10" wide.  
10" wide stainless steel fold-down work shelf  
Line-up interlock device  
Open understorage with shelf  
120V/60Hz/1-phase, 15 amp convenience outlet with breaker. 2-required  
Stainless Steel Exterior Panels  
Counter height to be modified to 32"-AFF.  
Daisy Chain electrical connections for Items 23 thru 26.

Item #: 26

Description: Serving Counter, Hot Food  
Manufacturer: Delfield  
Model #: SH-3-NU  
SIS #: T037  
Quantity: 1  
Alternate Manufacturer: Galley

Specification:

Exterior Body is constructed of 18 gauge stainless steel side panels and 14 gauge galvanized bottom. All exterior side panels are reinforced with overlapping corners and are welded in place. All body cutouts are reinforced with 14 gauge galvanized channel supports.  
Exterior Top shall be constructed of 14 gauge, type 304 stainless steel with No. 3 finish, welded, ground and polished into one integral unit. Top shall be fabricated with square exterior corners. Top shall have three electrically heated, recessed, die-stamped stainless steel hot food warmers. Each warmer shall accommodate a standard 12" x 20" x 6" deep hotel pan.

Heated Food Warmers are constructed of die-stamped stainless steel. Heated food warmers are fully insulated on all sides and bottom, and covered with an internal galvanized steel jacket. Each heated food warmer is individually equipped with a heating element rated at 1000 watts for 120 volt or 208/230 volt, 60 Hertz, single phase service and wired to an adjustable control switch and indicator light in the control panel. Heated food warmers are interwired to a minimum 10' long cord with a grounded plug for 120 volt or 208/230 volt, 60 hertz, single phase electrical service.

Casters; unit shall be mounted on 5" diameter swivel casters with non-marking polyolefin tires and plate brakes. Overall height of caster assembly shall be 6".

Options and Accessories:

12" wide stainless steel fold-down tray slides modified to be 10" wide.

10" wide stainless steel fold-down work shelf

Line-up interlock device

Glass front counter protector

Open understorage with shelf

Drains from food wells, plumbed to common valve.

Stainless Steel Exterior Panels

Counter height to be modified to 32"-AFF.

Daisy Chain electrical connections for Items 23 thru 26.

Plug configuration to be NEMA 14-50P

Item #: 27

Description: Tray Dispenser

Manufacturer: Delfield

Model #: TT2-1014

SIS #: T037

Quantity: 1

Alternate Manufacturer: Galley

Specification:

Framework shall be integrally welded 1.00" O.D. 16 gauge stainless steel tubing welded to a 16 gauge stainless steel base. Frame shall have stainless steel horizontal support rods affixed to the tubing. Base shall be reinforced with full-length 14 gauge stainless steel angles.

Unit shall have four 4" diameter polyolefin swivel casters (two locking), and non-marking gray sleeve bumpers.

Dispenser platform carrier shall be 18 gauge stainless steel and shall be removable for cleaning. Each dispenser shall have 2 self-leveling mechanisms.

Self-leveling mechanisms shall be field adjustable by adding or removing stainless steel extension springs located inside the elevator housings.

NOTE: Verify tray size with owner before ordering.

Item #: 28

Description: Tray & Silverware Dispenser

Manufacturer: Delfield

Model #: SCTS-28

SIS #: T037

Quantity: 1

Alternate Manufacturer: Galley

Specification:

Exterior body is constructed of 18-gauge stainless steel side panels and 14-gauge galvanized bottom. All exterior side panels are reinforced with overlapping corners and are welded in place. Stress points are reinforced with 14-gauge galvanized channel supports.

Exterior top is constructed of 14-gauge stainless steel, welded, ground and polished into one integral unit. Top is fabricated with square exterior corners. Top has area for silverware with step down for trays.

Casters; unit is mounted on 5" (12.7cm) diameter swivel casters with non-marking polyolefin tires and plate brakes. Overall height of caster assembly is 6" (15.2cm).

Options and Accessories:

Silverware cut outs with stainless silverware holders (SW)

Laminate Exterior Panels (Color to be selected by architects)

Item #: 29

Description: Milk Cooler

Manufacturer: Beverage Air

Model #: STF49 and STF58

SIS #: T037

Quantity: 2 (one of each model)

Alternate Manufacturer: Delfield

Specification:

Dual-access Twin-top, forced-air milk coolers are designed to hold milk between 32 and 38 until ready to serve. Produced in two sizes to hold 12 milk cases (13" x 13" x 11") for model STF49 and 16 milk cases (13" x 13" x 11") for the STF58 unit. Units will also accommodate (19" x 13" x 11") milk cases.

STF White exterior models are constructed of heavy duty white coated steel. Interior galvanized steel. Floors are heavily reinforced by seamless liner which minimizes joints. Heavy duty, epoxy coated steel wire floor racks are provided for added floor protection. Liner bottoms are made of 300 Series stainless.

Doors are fitted with flexible compression gaskets to ensure tight seal. All steel construction with 3-screw hinges add to model durability. Self-latching doors provide added convenience with safety bumpers standard. Dual evaporator evens airflow throughout coolers, completely enveloping contents in a blanket of cold air. One piece removable rack without the use of tools facilitates maintenance or repair.

Solar digital external thermometer, cylinder lock, latch safety bumpers, 1" ID bottom drain, and swivel casters (2 with locks) are provided as standard. Insulation is 1 1/2" inches thick foamed-in-place polyurethane, CFC free for compliance to environmental

concerns. This insulation further strengthens overall construction and is impervious to liquid penetration and resulting foul odor. Overall depth of 33 1/2 inches allow easy mobility and clear passage through most doorways.

Refrigerant used is 134a, which is CFC free for full compliance to all environmental concerns. Grounded service cord is provided at rear of cabinet for electrical plug in.

Item #: 30

Description: Condiment Cart

Manufacturer: Lakeside

Model #: 703-1 and 704-1

SIS #: T037

Quantity: 2 (one of each model)

Alternate Manufacturer: None

Specification:



Units to be model 703-1 and 704-1 Condi Express, Mobile Condiment Stations as manufactured by Lakeside. Units to provide an attractive self-service condiment dispensing alternative that complements your take away service. Rolls to any location where you need it. Utilizes convenient pump dispensers. Self-leveling dispensers for disposable condiment cups are available. Dispensers are housed in recesses to hold them securely and neatly in place. Three qt. dispenser jars recess into an internal ice bin for condiment refrigeration. Three serving heights are available putting the dispensers within reach of children, teens and adults. The wide counter provides a handy space for customer convenience. Sliding doors provide easy access to the interior storage space. Doors are located on the serving side for quick access when placed against a wall. Cart is sized for maneuvering into elevators, down corridors and into serving areas. Easy to maneuver with four tough-duty 5" casters, 2 swivel with brakes, two fixed. Stainless steel interior is easy to clean and sanitize. Solid laminate top is durable and easy to clean. Attractive Designer Series and solid color cabinet finishes are available. Standard color light gray and black countertop laminates coordinate with cabinet laminate finishes.

Top configuration #1. To includes 2 ea. 7 qt. Round Condiment Dispensers, 3 ea. 3 qt. Rectangular Condiment Dispensers and 2 ea. disposable cup dispensers.

One unit to have a 28" high counter height, the other unit to have a 36 ½" high counter height.

Item #: 31

Description: Can Opener (Not Shown on Plan)

Manufacturer: Edlund

Model #: U-12CL

SIS #: T037

Quantity: 1

Alternate Manufacturer: None

Specification:

Unit to be model U-12 CL NSF Universal Series Manual Can Opener as manufactured by Edlund. Unit to include opener with long bar and cast stainless steel clamp base.

Item #: 32

Description: Temperature Monitoring System (Not Shown on Plan)

Manufacturer: E-Controls, Inc

Model #: IntelliSense

SIS #: T037

Quantity: 1

Alternate Manufacturer: None

Specification:

Unit to be a complete IntelliSense, IntelliRinse, and IntelliCheck HACCP Inspection System for temperature monitoring of the following equipment list.

General Description: The IntelliSense Family of products is a low cost, feature rich line of hardware and software, used to wirelessly monitor an assortment of sensor types. The sensor data is measured by a battery powered IntelliSensor (which can accommodate up to 4 inputs), and transmitted wirelessly to the IntelliGate. The IntelliGate unit temporarily stores and processes all of the data from the IntelliSensor units and transmit

the received data over Ethernet or Wireless Ethernet (WiFi) using the IntelliGates built-in web server. The data can be viewed with a standard web browser or relayed to Raptor Web Software for Enterprise Wide Data Mining applications.

IntelliSensor units incorporate a 12-bit A/D Converter for accurate measurements of a wide variety of sensors. The IntelliSensor uses 128-bit AES encryption to transmit sensor data periodically based on a time or change in the value of a sensor reading (• T).

Multiple IntelliSensors can communicate with one IntelliGate at distances of up to 1 mile.

E-Control Systems IntelliCheck is a web-based handheld PC solution for managing and deploying HACCP and inspection programs for the Food Service industry and many school specific applications. Operators push a single button to perform temperature readings or checklists and IntelliCheck™ will do the rest.

Applications : Typical applications include, but are not limited to: food service (where the IntelliSensor, IntelliGate and IntelliCheck units can assist in monitoring and preventing HACCP violations), heating, cooling, refrigeration, HVAC, medical, and industrial. Multiple IntelliSensor units can communicate to a single IntelliGate Wireless Receiver for local data and alarm storage. IntelliSensors, IntelliGates, IntelliCheck and Raptor Web Software combine to create a full and complete data acquisition system.

General IntelliSense Family Features: No PC needed at the monitored site to operate the system. Hosting option by E-Control Systems means no software needed. Purchase option means no reoccurring monitoring fees. Have a fully integrated PDA using the same Raptor Web Software™ platform. The System is fully NAFEM Data Protocol Compliant. Same RWS software used to monitor temperature and operation of equipment in the kitchen. Collects data from system bypassing local firewalls. Ideal for self installation. Customization of Hardware/Software for large OEM customers. Supports Meshed Network topology for increased range. Encrypted communications

IntelliSensor Unit Features: Up to 4 inputs (Temperature, Door, Humidity, 4-20ma, 0-5VDC, etc.) connected to a single IntelliSensor. Up to 10 year battery life. Small Size measuring 3.290” x 2.420” x 1.000”. Built in Temperature and Humidity Sensors (optional). NIST Certified Sensor Readings (Optional). Reverse polarity protection on battery to protect internal circuitry during battery installation. Advanced data encryption and multi-level password support throughout the system. Conformal coating on all products for water resistant applications. User configurable transmission rate. Flame retardant ABS plastic enclosure with mounting flanges. Industrial Temperature Rating. CRC error checking on all data packets for reliable connection

IntelliGate Unit Features: Can connect to the network via Ethernet or Wireless Ethernet (WiFi). Built-in dual sensor input, saves an additional wireless sensor. Has one dry contact output for connection to external building management or alarm system. Advanced data encryption and multi-level password support throughout the system. Built-in Web Server to display current and past sensor data and alarms. Can push XML data to Enterprise Server(s). Conformal coating for water resistant applications. Flame retardant ABS plastic enclosure with mounting flanges. FCC, IC, and CE agency certified for worldwide operation. Industrial Temperature Rating. CRC error checking on all data packets for reliable connection.

Equipment to be Monitored

Item #	Description
5 - #1	Rational, Combi-Oven
5 - #2	Rational, Combi-Oven
6	Victory, 2-Dr, Roll-in Refrigerator
7	Victory, 1-Dr, Roll-in Refrigerator
8	Victory, 1-Dr, Roll-in Freezer
10 - #1	Winston, Therm & Hold Cabinet
10 - #2	Winston, Therm & Hold Cabinet
16	Meiko, Undercounter Dishwasher
19	Delfield, Serving Counter, Heated Module
20	Delfield, Serving Counter, Cold Food
24	Delfield, Serving Counter, Cold Food
26	Delfield, Serving Counter, Hot Food

- 29 - #1 Beverage Air, Milk Cooler
- 29 - #2 Beverage Air, Milk Cooler

IntelliSense Wireless Temperature Monitoring System:

- (1) IntelliGate Unit
- (1) Power Supply
- (1) Ethernet Cable
- (1) Intellisensor TempNTC-40
- (4) Intellisensor TempNTC-10
- (7) Standard Temperature Sensors
- (1) Hardware Installation - IntelliSense

IntelliRinse for Dishwasher Final Rinse Monitoring:  
System to include the following:

- (1) IntelliRinse + Dish-11 Kit
- (1) Hardware Installation – IntelliRinse

IntelliCheck HACCP Inspection System

- (1) IntelliCheck PDA Remote software installation

System to include the following:

- (1) IntelliCheck PDA
- (1) IntelliCheck PDA Enclosure
- (1) IntelliProbe wireless probe
- (1) Power Supply

Additional Items Required:

- (1) Raptor Web Software™ (RWS) - One Software License with IntelliSense, IntelliRinse, & IntelliCheck applications.
- (1) RWS - Annual Software Support and Software Upgrades for 1st Year
- (1) RWS Remote Software Configuration and Hardware Integration – IntelliSense.
- (1) Rational, Combi-Oven software integration (see note 5)

Notes:

- (1) Hardware installation to be done by E-CONTROL SYSTEMS authorized installer (on-site installation including connection of sensors, one trip).
- (2) CUSTOMER TO PROVIDE an Ethernet connection and power outlet within a 5-foot distance from the IntelliGate unit to connect to existing network in a central location, near ceiling, as well as any other electrical work or wiring.
- (3) Software installation to be done remotely by E-CONTROL SYSTEMS
- (4) CUSTOMER TO PROVIDE computer, printer, and all equipment necessary for Ethernet connection and for networking as well as an available USB port for the PDA upload. See system specification for PC requirements.
- (5) E-Controls Systems will provide remote support for Rational integration of the Combi-Ovens into RWS software, provided it is HACCP ready, installed and configured by Rational.
- (6) Prices based on a wide-area network (WAN) system

Item #: 33

Description: Traffic Barriers (Not Shown on Plan)

Manufacturer: Brassmith

Model #: 940/20-87 & 942

SIS #: T037

Quantity: 2

Alternate Manufacturer:

## Specification:

Units to be model 940/20-87 wall mounted beltway and model 942 wall mounted receptacle as manufactured by Brassmith. Head and Belt color to be verified by owner before ordering.

Item #: 34

Description: P.O.S. System (Not Shown on Plan)

Manufacturer: Revenue Control Systems, Inc.

Model #: Custom Fastrak

SIS #: T037

Quantity: 1

Alternate Manufacturer: None

## Specification:

System to be a complete FASTRAK Cafeteria System as supplied and installed by Revenue Control Systems, Inc. 560 Sylvan Avenue, Englewood Cliffs, NJ. 07632 Phone # 1 (800) 247-3061.

System shall include:

## Cafeteria Software:

- (1) Fastrak School Site License
- (2) Fastrak 3D-POS Point of Sale Software

## Cafeteria Hardware:

- (2) SilenTouch II Terminal with HD/XP PRO/1 GB Ram – Includes 3 year cross ship warranty (for standalone locations)
- (2) USB Electronic Cash Drawers
- (3) FRED (Fast Read Entry Device) (3 year warranty)
- (1) Keyboard and Mouse

## Turn Key Installation and Training

- (2) On Site Training and Setup Days.
- (1) On Site "Go Live Days"
- (\*) All "On Site", training, go live, and setup fees are plus employee per diem, travel and travel related expenses to be invoiced at cost to the owner and shall not be part of the Foodservice Equipment Contract.

## 3D-POS, Point of Sale Software for Fastrak:

Application: 3D-POS Terminal Software is a full service Point-of-Sale solution. 3D-POS features unique Point-of-Sale functionality that duplicates PCS' smart POS terminal keyboard design and allows for Keyboard or Touch Screen capability.

Features: Runs on MS Windows 98/2000/NT/XP. Touch Screen, mouse and keyboard

Accessible. "Hands Free" Express Mode to speed lines. Split screen functionality for dual line operation. Roster Mode with pictures for classroom service. Full Service Mode or à-la-carte sales. Automated voice prompts to control lines. Supports one or two keypads/scanners. Large, easy-to-read buttons. 20 to 80 Item key display. Supports "Hand Held" and "Wireless" POS. Left or Right Hand Operation. Fully Configurable Keys/Names/Layout. Utilize Menu Picture Keys. Incorporate Color for Itemization Speed Cafeteria Lines with 3D-POS: PCS' POS technology for any computer platform-3D-POS-PC for Windows and 3D-POS-WW for Windows and Web.

## SilenTouch-II POS/PC Appliance for Fastrak:

What's the Big Deal about the SilenTouch-II ? One word - FANLESS! Using the ultra low power Intel Mobile Celeron processor, the CPU generates less heat, eliminating the need for cooling fans. This means less breakdown, less maintenance and reassurance the SilenTouch-II will always do its job. Uses low power Intel Mobile Celeron (No CPU fan required). External power supply, eliminates another internal fan. Low heat = no fans = fewer breakdowns = less maintenance. WePOS Operating System. Small footprint. 3-year warranty & 3-year cross-ship.

Technical Features: Display: 15.1" display. Touch Screen: 5-wire resistive touch screen. CPU: Intel Mobile Celeron 1.0 GHz. Memory: 512 MB RAM. Hard Drive: 40 GB 2.5" laptop hard drive. Wireless: Mini-PCI wireless. Network: 10/100 ethernet. USB: 4 USB. Serial Ports: 4 X RJ45 RS232 port with adapters provided. Parallel Port: One LPT Port

Power: External power supply. Part Number: 027FTST2.

FRED and NED POS Numeric Keypad for Fastrak:

The FRED Fast Read Entry Device with Dual Operation – Numeric Keypad and Barcode Scanner: Students and teachers can enter a system generated PIN or district generated ID on the keypad or they can scan their ID card on the same convenient device.

The NED Numeric Entry Device – without Barcode Scanner: The NED saves money for operations not requiring a barcode scanner and can be upgraded with a barcode scanner when needed. The NED can be set for entry of system generated PIN numbers or student ID numbers.

Security Identification Features: Once the account has been activated, the POS will display the student name and picture (if available). A secondary verification of identity field, such as birthday, teacher initials, student ID, etc. is also displayed. The secondary verification field may be changed from time to time, if needed.

Unique Account Security Features: For operations not utilizing the picture identification feature of the point of sale, the FRED and NED keypads include some unique features that are incorporated to ensure security of account access. For each student account code a security digit is assigned automatically by the system to create a unique keypad number or PIN. The FRED and NED keypads calculate the security digit, on-the-fly, as the student enters his/her PIN and rejects incorrect entries. Any mismatch causes an account

rejection accompanied with an audible alarm. The security digit protects the system against the keying of random numbers that match an existing account, and prevents accidental access of an account. A student would have to make two mistakes in keying the account code in order to accidentally type another valid code.

Built-in Detective Features: In the event a keypad number (PIN) is entered incorrectly, either by mistake or on purpose by someone trying to receive another student's meal, such an event can be detected and traced in the system. The system provides the capability to investigate and correct such transactions, and in some cases to track down the individual that used someone else's account code (PIN).

END OF SECTION 114000

## SECTION 115213-PROJECTION SCREENS

## 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. Manually operated projection screens.
  - 2. Electrically operated projection screens and controls.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For projection screens. Show layouts and types of projection screens. Include the following:
  - 1. For electrically operated projection screens and controls:
    - a. Location of screen centerline relative to ends of screen case.
    - b. Location of wiring connections for electrically operated units.
    - c. Location of seams in viewing surfaces.
    - d. Drop lengths.
    - e. Anchorage details, including connection to supporting structure for suspended units.
    - f. Details of juncture of exposed surfaces with adjacent finishes.
    - g. Accessories.
    - h. Wiring diagrams.
- C. Maintenance Data: For projection screens to include in maintenance manuals.

## PART 2 - PRODUCTS

## 2.1 MANUALLY OPERATED PROJECTION SCREENS

- A. General: Manufacturer's standard spring-roller-operated units, consisting of case, screen, mounting accessories, and other components necessary for a complete installation.
  - 1. Screen Mounting: Top edge securely anchored to a 3-inch- diameter, rigid steel roller; bottom edge formed into a pocket holding a tubular metal slat, with ends of slat protected by plastic caps, and with a saddle and pull attached to slat by screws.

- B. Bracket-Mounted, Metal-Encased, Manually Operated Screens: Units designed and fabricated for suspending from wall brackets or ceiling, fabricated from formed-steel sheet not less than 0.027 inch thick or from aluminum extrusions; with vinyl covering or baked-enamel finish and matching end caps. Provide mounting brackets unless otherwise indicated.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Bretford, Inc.; Series 65.
  - b. Da-Lite Screen Company; Model B, with model no. 6 brackets.
  - c. Draper Inc.; Luma.

## 2.2 ELECTRICALLY OPERATED PROJECTION SCREENS

- A. General: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Controls: Remote, three-position control switch installed in recessed device box with flush cover plate matching other electrical device cover plates in room where switch is installed.
  - a. Provide one control switch with key lock.
  - b. Provide power supply for low-voltage systems if required.
2. Motor in Roller: Instant-reversing motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.
3. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch-diameter metal rod with ends of rod protected by plastic caps.
  - a. Roller for motor in roller supported by vibration- and noise-absorbing supports.
4. Tab Tensioning: Provide units that have a durable low-stretch cord, such as braided polyester, on each side of screen connected to edge of screen by tabs to pull screen flat horizontally.

- B. Suspended, Electrically Operated Screens without Ceiling Closure: Motor-in-roller units designed and fabricated for suspended mounting, with bottom of case entirely or partially open under screen compartment.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Motor in Roller:
    - 1) BEI Audio-Visual Products; Alpine XL.
    - 2) Da-Lite Screen Company; Advantage Electrol.
    - 3) Draper Inc.; Envoy.
    - 4) Stewart Filmscreen Corporation; Model A-B.
2. Provide metal or metal-lined wiring compartment on units with motor in roller.
3. Screen Case: Made from metal.
4. Provide screen case with trim flange to receive ceiling finish.
5. Finish on Exposed Surfaces: Vinyl covering or baked enamel.

### 2.3 FRONT-PROJECTION SCREEN MATERIAL

- A. Matte-White Viewing Surface: Peak gain not less than 0.9, and gain not less than 0.8 at an angle of 50 degrees from the axis of the screen surface.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. BEI Audio-Visual Products; Matte White.
    - b. Da-Lite Screen Company; Matte White.
    - c. Draper Inc.; Fiberglass Matte White.
- B. Material: Vinyl-coated, glass-fiber fabric.
- C. Mildew-Resistance Rating: 0 or 1 when tested according to ASTM G 21.
- D. Flame Resistance: Passes NFPA 701.
- E. Flame-Spread Index: Not greater than 75 when tested according to ASTM E 84.
- F. Seamless Construction: Provide screens, in sizes indicated, without seams.
- G. Edge Treatment: Black masking borders.
- H. Size of Viewing Surface:
  - 1.

## PART 3 - EXECUTION

### 3.1 FRONT-PROJECTION SCREEN INSTALLATION

- A. Install front-projection screens at locations indicated to comply with screen manufacturer's written instructions.
- B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.
  - 1. Install low-voltage controls according to NFPA 70 and complying with manufacturer's written instructions.
    - a. Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
  - 2. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.

END OF SECTION 115213



## SECTION 116143 - STAGE CURTAINS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes stage curtain rigging and the following types of stage curtains:
  - 1. Front-setting curtains including front curtain and valance.
- B. Related Sections include the following:
  - 1. Division 01 Section "Alternates" for information on alternate pertaining to this section.
  - 2. Division 05 Section "Metal Fabrications" for supplementary members supporting stage curtain systems to structure.

## 1.2 SUBMITTALS

- A. Product Data: Include types, styles, materials, operating instructions, and maintenance recommendations. Include data on stage equipment.
- B. Shop Drawings: Include plans, elevations, and detail sections of typical track and rigging elements, equipment and acoustic shells. Show anchors, hardware, operating equipment, and other components not included in manufacturer's Product Data. Include the following:
  - 1. Locations for blocking to be provided by others.
  - 2. Extent of required operating clearances.
  - 3. Calculations: Calculate requirements for supporting curtains, track, and equipment and verify capacity of each curtain, track, and rigging component to support loads.
  - 4. Locations of equipment components.
- C. Samples for Selection: Manufacturer's color charts showing the full range of colors, textures, and patterns available, together with 12-inch- square sample (any color) of each type fabric.
- D. Product Certificates: Signed by manufacturers of stage curtains certifying that products furnished comply with requirements. Give name of flame-retardant chemical used, identification of applicator, treatment method, application date, allowable life span for treatment, and details of any restrictions and limitations.

## 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed installation of stage curtains similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Fire-Test-Response Characteristics: Provide stage curtains with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or a testing and inspecting agency acceptable to authorities having jurisdiction. Permanently attach label to each fabric of curtain assembly indicating whether fabric is inherently and permanently flame resistant, or treated with flame-retardant chemicals, and whether it will require retreatment after designated time period or cleaning.

1. Flame-Resistance Ratings: Passes NFPA 701.

#### 1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify stage curtain openings and dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening and construction dimensions and proceed with fabricating stage curtains without field measurements. Coordinate construction to ensure that actual opening and construction dimensions correspond to established dimensions.

### PART 2 - PRODUCTS

#### 2.1 CURTAIN FABRICS

- A. General: Provide fabrics inherently and permanently flame resistant to comply with requirements indicated. Provide fabrics from the same dye lot.
- B. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range for these characteristics.
- C. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  1. Woven Cotton Velour:
    - a. #2703 Overture; JB Martin Ltd.
    - b. #31010 Metro; J. L. de Ball America, Inc.
    - c. Memorable; KM Fabrics, Inc.

#### 2.2 FRONT-SETTING CURTAIN FABRIC

- A. Woven Cotton Velour: Napped fabric of 100 percent cotton; 54-inch minimum width; and other characteristics as follows:
  1. Heavyweight: Fabric weighing not less than 25 oz./linear yard before flame-retardant treatment, with pile height not less than 79 mils.
- B. Lining: Yarn-dyed denim cloth of 100 percent cotton; woven in a warp-faced twill; 54-inch minimum width.

#### 2.3 METAL

- A. Steel Pipe: ASTM A 53, Grade A, standard weight (Schedule 40), black, 1-1/2-inch nominal diameter, unless otherwise indicated.
- B. Galvanized Steel Sheet: Commercial-quality, zinc-coated, carbon-steel sheet; complying with ASTM A 653/A 653M, G60 coating designation.

- C. Supports, Clamps, and Anchors: Sheet steel in manufacturer's standard thicknesses, galvanized after fabrication according to ASTM A 153/A 153M, Class B.
- D. Trim and Support Cable: 1/4-inch- diameter, 7x19 galvanized steel aircraft cable with a breaking strength of 7000 lb. Provide fittings complying with cable manufacturer's written recommendations for size, number, and method of installation, including a drop-forged galvanized turnbuckle to allow for leveling.
- E. Inserts, Bolts, Rivets, and Fasteners: Manufacturer's standard corrosion-resistant units.

## 2.4 CURTAIN FABRICATION

- A. General: Affix permanent label, stating compliance with requirements of authorities having jurisdiction, in accessible location on curtain not visible to audience. Provide vertical seams, unless otherwise indicated. Arrange vertical seams so they do not fall on faces of pleats. Do not use fabric cuts less than half width.
  - 1. Vertical Hems: Provide vertical hems not less than 2 inches wide, with not less than a 1-inch tuck, and machine-sewn with no selvage material visible from front of curtain. Sew open ends of hems closed.
  - 2. Leading Edge Turnbacks: Provide turnbacks formed by folding not less than 12 inches of face fabric back, with not less than a 1-inch tuck, and secured by sewing turnback vertically.
  - 3. Top Hems: Reinforce top hems by double-stitching 3-1/2-inch- wide, heavy jute webbing to top edge with not less than 2 inches of face fabric turned under.
  - 4. Pleats: Provide 50 percent fullness in curtains, exclusive of turnbacks and hems, by sewing additional material into 3-inch double-stitched box pleats spaced at 12 inches o.c. along top hem reinforcement.
  - 5. Grommets: Brass, centered on box pleats and 1 inch from corner of curtain, for snaps or S-hooks.
    - a. Provide not less than No. 2 grommets except, for velour curtains, provide not less than No. 3 grommets.
    - b. For black curtains, provide brass or aluminum grommets with a black finish.
  - 6. Bottom Hems: For curtains that do not hang to the floor, provide hems not less than 3 inches deep with 3/4-inch weight tape. For floor-length curtains, provide hems not less than 6 inches deep with separate, interior, 100 percent cotton, heavy canvas chain pocket equipped with No. 8 plated jack chain. Stitch chain pockets so chain will ride 2 inches above finished bottom edge of curtain.
  - 7. Velour Curtains: Fabricate with the fabric nap down.
  - 8. Lining: Provide lining for each curtain in same fullness as face fabric, and finished 2 inches shorter than face fabric. Attach lining to face fabric along bottom and side seams with 4-inch-long strips of heavy woven cotton tape.
- B. S-Hooks: Track manufacturer's heavy-duty plated wire hooks.
- C. Snap Hooks: Track manufacturer's heavy-duty hooks.
- D. Tie Lines: Braided soft cotton, black or white to best match curtain; not less than 5/8 inch wide by 36 inches long.

## 2.5 STRAIGHT CURTAIN TRACK FABRICATION

- A. Steel-Track Channels: Fabricate of roll-formed galvanized steel sheet, with continuous bottom slot, and with each half of track in one continuous piece.

1. Minimum Base-Metal Thickness: Not less than 0.0528 inch.
- B. Heavy-Duty Track System: Equip track with heavy-duty, live-end, double-wheel pulley; heavy-duty, dead-end, single-wheel pulley; and adjustable, heavy-duty floor block; each with not less than 5-inch molded-nylon- or glass-filled-nylon-tired ball-bearing wheels, enclosed in steel housings. Provide single curtain carriers of molded nylon with a pair of neoprene-tired ball-bearing wheels riveted parallel to body. Provide one master carrier, for each leading curtain edge, of plated steel with two pairs of nylon-tired ball-bearing wheels and with two line guides per carrier. Equip carriers with neoprene or rubber bumper to reduce noise, and heavy-duty, plated-steel swivel eye and manufacturer's standard trim chain for attaching curtain snap or S-hook. Provide end stops for track. Design adjustable floor block to maintain proper tension on operating line.
1. Operating Line: Manufacturer's standard 3/8-inch stretch-resistant operating cord consisting of braided synthetic-fiber jacket over solid, synthetic-fiber, linear, center filaments.
- C. Products: Subject to compliance with requirements, provide one of the following:
1. Silent Steel Model No. 281 with No. 2863, No. 2864, and No. 2866 pulleys; Automatic Devices Company.
  2. Atlas Silk Model No. 418S; H & H Specialties, Inc.
  3. Tru-Roll Model No. 1000; Tru-Roll, Inc.
  4. Besteel Model No. 170; Automatic Devices Company.
  5. Atlas Silk Model No. 101S; H & H Specialties, Inc.
  6. Tru-Roll Model No. 1200; Tru-Roll, Inc.
  7. Besteel Model No. 173; Automatic Devices Company.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for supporting members, blocking, installation tolerances, clearances, and other conditions affecting performance of stage curtain work. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Examine inserts, clips, blocking, or other supports required to be installed by others to support tracks and battens. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION, GENERAL

- A. Install stage curtain system according to track manufacturer's and curtain fabricator's written instructions.

### 3.4 BATTEN INSTALLATION

- A. Install battens by suspending at heights indicated with steel cables spaced to support load, but do not exceed 10 feet o.c. between cables.
- B. Secure cables either directly to structures or to inserts, eye screws, or other devices that are secure and appropriate to substrate and that will not deteriorate or fail with age or elevated temperatures. Attach

other cable end to pipe clamps with turnbuckles, moused or fixed with nuts after adjustment, to prevent loosening.

### 3.5 TRACK INSTALLATION

- A. Batten-Hung Tracks: Install track by suspending from pipe batten with manufacturer's track clamp hangers attached to batten pipe clamps at spacing, according to manufacturer's written instructions.
  - 1. Heavy-Duty Track: Do not exceed 72 inches between supports.
  - 2. Curved Walk-Along Track: Do not exceed 48 inches between supports, and provide additional supports at curves and splices.
- B. Install track for center-parting curtains with not less than 24-inch overlap of track sections at center, supported by special lap clamps.

### 3.6 CURTAIN INSTALLATION

- A. Track Hung: Secure curtains to track carriers with track manufacturer's special heavy-duty S-hooks or snap hooks.

END OF SECTION 116143

## SECTION 116623 - GYMNASIUM 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. This Section includes the following gymnasium equipment:
  - 1. Basketball equipment.
  - 2. Volleyball equipment.
  - 3. Safety pads.
- B. Related Sections include the following:
  - 1. Division 03 Section "Cast-in-Place Concrete" for installation of floor insert sleeves to be cast in concrete slabs and footings.

## 1.3 DEFINITIONS

- A. NFHS: The National Federation of State High School Associations.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Provide basketball backboards capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
  - 1. Refer to the structural drawings for seismic requirements.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.
- B. Shop Drawings: For gymnasium equipment. Include plans, elevations, sections, details, attachments to other work, and the following:
  - 1. Method of field assembly for removable equipment, connections, installation details, mountings, floor inserts, attachments to other work, and operational clearances.
  - 2. Transport and storage accessories for removable equipment.

- C. Structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation including loads, point reactions, and locations for attachment of gymnasium equipment to structure.
- D. Coordination Drawings: Court layout plans, drawn to scale, and coordinating floor inserts, game lines, and markers applied to finish flooring.
- E. Samples for Selection: For each type of gymnasium equipment indicated.
  - 1. Pad Fabric: Not less than 3 inches square, with specified treatments applied. Mark face of material.
- F. Product Certificates: For each type of gymnasium equipment, signed by product manufacturer.
- G. Operation and Maintenance Data: For gymnasium equipment to include in emergency, operation, and maintenance manuals.
- H. Warranty: Special warranty specified in this Section.

#### 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of gymnasium equipment through one source from a single manufacturer.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install gymnasium equipment until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.

#### 1.8 COORDINATION

- A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring.
- B. Coordinate layout and installation of overhead-supported gymnasium equipment and suspension system components with other construction including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

#### 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  - 1. Extruded Bars, Profiles, and Tubes: ASTM B 221.
  - 2. Cast Aluminum: ASTM B 179.
  - 3. Flat Sheet: ASTM B 209.
- B. Steel: Comply with the following:
  - 1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
  - 2. Steel Tubing: ASTM A 500 or ASTM A 513, cold formed.
  - 3. Steel Sheet: ASTM A 1011/A 1011M.
- C. Support Cable: 1/4-inch- diameter, 7x19 galvanized steel aircraft cable with a breaking strength of 7000 lb. Provide fittings complying with cable manufacturer's written instructions for size, number, and method of installation.
- D. Castings and Hangers: Malleable iron, ASTM A 47/A 47M, grade required for structural loading.
- E. Softwood Plywood: DOC PS 1, exterior.
- F. Anchors, Fasteners, Fittings and Hardware: Manufacturer's standard corrosion-resistant or noncorrodible units; concealed.
- G. Grout: Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107 with minimum strength recommended in writing by gymnasium equipment manufacturer.

## 2.2 BASKETBALL EQUIPMENT

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Porter Athletic Equipment Co. or a comparable product by one of the following:
  - 1. Basketball Equipment:
    - a. AALCO.
    - b. Draper Manufacturing.
    - c. Institutional Products, Inc.
  - 2. Volleyball Equipment:
    - a. AALCO.
  - 3. Wall-Mounted Safety Pads:
    - a. AALCO.
    - b. Draper Shade & Screen Co., Inc.
    - c. Institutional Products, Inc.
- B. General: Provide equipment complying with requirements in NFHS's "NFHS Basketball Rule Book."



- C. Protruding fasteners or exposed bolt heads on front face of backboards are not permitted.
- D. Overhead-Supported Backboards (Folding):
  - 1. Folding Type: Provide manufacturer's standard assembly for forward-folding, rear-braced backboard, with hardware and fittings to permit folding.
    - a. Basis-of-Design Product: Provide No. 917 Forward Fold.
  - 2. Framing: Steel pipe, tubing, and shapes. Design framing to minimize vibration during play.
    - a. Center-Mast Frame: Welded with side sway bracing.
    - b. Finish: Manufacturer's standard powder-coat finish.
  - 3. Goal Height Adjuster: Adjustable from 8 to 10 feet with gear-drive mechanism, locking in any position within adjustment range, with visible height scale attached to side of framing.
    - a. Operation: Manual with detachable crank handle.
- E. Overhead-Supported Backboards (Stationary):
  - 1. Stationary Type: Provide manufacturer's standard assembly for stationary backboard.
    - a. Basis-of-Design Product: Provide No. 918 Stationary Backstop.
  - 2. Framing: Steel pipe, tubing, and shapes. Design framing to minimize vibration during play.
    - a. Center-Mast Frame: Welded with side sway bracing.
    - b. Finish: Manufacturer's standard powder-coat finish.
  - 3. Goal Height Adjuster: Adjustable from 8 to 10 feet with gear-drive mechanism, locking in any position within adjustment range, with visible height scale attached to side of framing.
    - a. Operation: Manual with detachable crank handle.
- F. Winch: Hoist, consisting of heavy-duty, fully enclosed worm-gear, brake, cable drum, cable, and fittings, for mounting on wall with equipment mounting board; designed to move and hold backboard in any raised or lowered position.
  - 1. Operation: Manual winch with detachable hand crank.
  - 2. Portable Winch Operator: One portable electric motor-drive device, including adaptor to fit crank mechanism.
- G. Basketball Backboard:
  - 1. Shape and Size:
    - a. Rectangular, 72 by 42 inches width by height.
  - 2. Glass Backboard Material: With predrilled holes or preset inserts for mounting goals, and as follows:
    - a. Glass: Not less than 1/2-inch- thick, transparent tempered glass. Provide glass with impact-absorbing resilient rubber or PVC gasket around perimeter in a fully welded, painted steel frame, with steel subframe, reinforcement, and bracing, including center-strut

frame reinforcement, and with mounting slots for mounting backboard frame to backboard support framing.

- 1) Rim-Restraining Device: Complying with NCAA and NFHS rules and designed to ensure that basket remains attached if glass backboard breaks.
  - b. Target Area and Border Markings: Permanently etched in white color, marked in manufacturer's standard pattern and stripe width.
- H. Goal Mounting Assembly: Compatible with goal, backboard, and support framing; with hole pattern that is manufacturer's standard for goal attachment.
1. Glass Backboard Goal Mounting Assembly: Goal support framing and reinforcement designed to transmit load from goal to backboard frame and to minimize stresses on glass backboard.
- I. Basketball Goals: Complete with flanges, braces, attachment plate, and evenly spaced loops welded around underside of ring.
1. Single-Rim Basket Ring Competition Goal: Materials, dimensions, and fabrication complying with referenced rules.
  2. Type: Movable, breakaway design with manufacturer's standard breakaway mechanism and rebound characteristics identical to those of fixed, nonmovable ring.
  3. Mount: Front.
  4. Net Attachment: No-tie loops for attaching net to rim without tying.
  5. Finish: Manufacturer's standard finish.
- J. Basketball Nets: 12-loop-mesh net, between 15 and 18 inches long, sized to fit rim diameter, and as follows:
1. Competition Cord: Antiwhip, made from white nylon cord not less than 120- or more than 144-gm thread.
- K. Backboard Safety Pads: Designed for backboard thickness indicated and extending continuously along bottom and up sides of backboard and over goal mounting and backboard supports as per manufacturer's standard design.
1. Attachment: Manufacturer's standard.
  2. Color: As selected by Architect from manufacturer's full range.
- L. Backstop/Backboard Safety Device: Designed to limit free fall if support cable, support chain, pulleys, fittings, winch, or related components fail; with mechanical automatic reset; 6000-lb load capacity; one per backstop.
1. Retractor Device: Manufacturer's standard device designed to retract both support and safety cables, chains, and straps away from play of the basketball when backstop is in playing position; one per folding backstop.

### 2.3 VOLLEYBALL EQUIPMENT

- A. Basis-of-Design Product: Subject to compliance with requirements, provide No. 1971 Power Rib II Competition Sleeve-Type Volleyball System by Porter Athletic Equipment Co. or a comparable product by one of the following:
1. Volleyball Equipment:

a. AALCO.

- B. Floor Insert: Solid-brass floor plate; and steel pipe sleeve, concealed by floor plate, with capped bottom end, sized with ID to fit post standards, not less than 12 inches long to securely anchor pipe sleeve below finished floor in concrete footing; with anchors designed for securing floor insert to floor substrate indicated; one per post standard.
1. Floor Plate: Lockable swivel access cover, designed for use with floor type and to be flush with adjacent flooring. Provide two tool(s) for unlocking access covers.

2.4 SAFETY PADS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Porter Athletic Equipment Co. or a comparable product by one of the following:
1. AALCO Manufacturing.
  2. Draper Inc.
  3. Institutional Products Inc.
- B. Safety Pad Surface-Burning Characteristics: ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Flame-Spread Index: 25 or less.
  2. Smoke-Developed Index: 450 or less.
- C. Pad Coverings: Provide safety pad fabric covering fabricated from puncture- and tear-resistant, not less than 14-oz./sq. yd PVC-coated polyester or nylon-reinforced PVC fabric treated with fungicide for mildew resistance; with surface-burning characteristics indicated, and lined with fire-retardant liner.
- D. Wall Safety Pads: Padded wall wainscot panels designed to be attached in a continuous row; each panel section consisting of fill laminated to backer board with visible surfaces fully covered by seamless fabric covering, free of sag and wrinkles and firmly attached to back of backer board.
1. Backer Board: Not less than 3/8-inch- thick plywood, mat formed, or composite panel.
  2. Fill: Multiple-impact-resistant foam not less than 2-inch- thick polyurethane, 3.5-lb/cu. ft. density.
  3. Size: Each panel section, 24 inches wide by not less than 72 inches long.
  4. Number of Panel Sections: As indicated modular panel sections.
  5. Installation Method: Provide Wall Stor-Strip with 1-1/2 inch wide Velcro.
  6. Fabric Covering Color: As selected by Architect from manufacturer's full range for one color.
- E. Corner Wall Safety Pads: Wall corner pad consisting of not less than 1-1/4-inch- thick, multiple-impact-resistant, closed-cell polyethylene-foam filler, covered on both sides and all edges by fabric covering with backer board and manufacturer's standard Velcro anchorage to wall.
1. Length: Each pad not less than 72 inches and as required at sides and head of doors.
  2. Fabric Covering Color: As selected by Architect from manufacturer's full range for one color.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances, and other conditions affecting performance.
  - 1. Verify critical dimensions.
  - 2. Examine supporting structure and subgrades, subfloors and footings below finished floor.
  - 3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements have been clearly marked. Locate reinforcements and mark locations.
  - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written installation instructions and competition rules indicated for each type of gymnasium equipment. Complete equipment field assembly, where required.
- B. Unless otherwise indicated, install gymnasium equipment after other finishing operations, including painting, have been completed.
- C. Permanently Placed Gymnasium Equipment and Components: Rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated on Shop Drawings; in proper relation to adjacent construction; and aligned with court layout.
  - 1. Floor Insert Location: Coordinate location with application of game lines and markers.
  - 2. Floor Insert Elevation: Coordinate installed heights of floor insert with installation and field finishing of finish flooring and type of floor plate.
  - 3. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.
- D. Floor Insert Setting: Position sleeve in oversized, recessed voids in concrete slabs. Clean voids of debris. Fill void around sleeves with grout, mixed and placed to comply with grout manufacturer's written instructions. Protect portion of sleeve above subfloor from splatter. Verify that sleeves are set plumb, aligned, and at correct height and spacing; hold in position during placement and finishing operations until grout is sufficiently cured. Set insert so top surface of completed unit is flush with finished flooring surface.
- E. Wall Safety Pads: Mount with bottom edge at 4 inches above finished floor.
- F. Anchoring to In-Place Construction: Use anchors and fasteners where necessary for securing built-in and permanently placed gymnasium equipment to structural support and for properly transferring load to in-place construction.
- G. Connections: Connect automatic operators to building electrical system.
- H. Removable Gymnasium Equipment and Components: Assemble in place to verify that equipment and components are complete and in proper working order. Instruct Owner's designated personnel in properly handling, assembling, adjusting, disassembling, transporting, storing, and maintaining units. Disassemble removable gymnasium equipment after assembled configuration has been approved by Owner, and store units in location indicated on Drawings.

## 3.3 ADJUSTING

- A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

## 3.4 CLEANING

- A. After completing gymnasium equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.
- B. Replace gymnasium equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 116623

## SECTION 122413-ROLLER SHADES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes:
  - 1. Room darkening shades.
  - 2. Light filtering shades.

## 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
- B. Samples for Selection: For each colored component of each type of roller shade indicated.
  - 1. Include similar Samples of accessories involving color selection.
- C. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
  - 1. Methods for maintaining roller shades and finishes.
  - 2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
- D. Window Treatment Schedule.

## 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed installation of roller shades similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations: Obtain roller shades through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Flame-Resistance Ratings: Passes NFPA 701.
  - 2.
  - 3.

## 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in a window treatment schedule.

## 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Manual Flexshades by Draper or comparable product by one of the following:
  - 1. Joanna Roller Shade by Levolor.
  - 2. Kirsch.
  - 3. Mechoshade.

### 2.2 ROLLER SHADE TYPES

- A. Manually Operated Shades:
  - 1. Mounting: Jamb mounted.
  - 2. Configuration:
    - a. Single shades.

### 2.3 ROLLER SHADES

- A. Solar Shade Band Material: PVC-coated fiberglass and polyester blends.
  - 1. Fabric Width: As required for windows.
  - 2. Pattern: To be determined.
  - 3. Style: Sheerweave SW2400 by Phifer.
  - 4. Colors: As selected by Architect from manufacturer's full range
  - 5. Material Openness Factor: 3 percent open.
  - 6. Bottom Hem: Straight.
- B. Blackout Shade Band Material: PVC-coated fiberglass and polyester blends.
  - 1. Fabric Width: As required for windows.
  - 2. Pattern: To be determined.
  - 3. Style: Sheerweave SW7100 by Phifer.
  - 4. Colors: As selected by Architect from manufacturer's full range
  - 5. Bottom Hem: Straight.
- C. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with manufacturer's standard method for attaching shade material. Provide capacity for one roller shade band per roller, unless otherwise indicated on Drawings.
- D. Direction of Roll: Regular, from back of roller.

- E. Mounting Brackets: Galvanized or zinc-plated steel.
- F. Shade Operation: Manual; with continuous loop bead chain, clutch, and cord tensioner and bracket.
  - 1. Position of Clutch Operator: Right side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings.
  - 2. Clutch: Capacity to lift size and weight of shade; sized to fit roller or provide adaptor.
  - 3. Bead Chain: Nickel-plated metal.
  - 4. Operating Function: Stop and hold shade at any position in ascending or descending travel.
  - 5. Chain Hold Down: Install for all chains.
- G. Mounting: Wall type mounting on gypsum sidewalls permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

## 2.4 FABRICATION

- A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.
- B. Concealed Components: Non-corrodible or corrosion-resistant-coated materials.
  - 1. Lifting Mechanism: With permanently lubricated moving parts.
- C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:
  - 1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
- D. Installation Fasteners: Not fewer than two fasteners per bracket, fabricated from metal non-corrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
- E. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

### 3.3 ADJUSTING



- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

### 3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

### 3.5 SCHEDULE

- A. Provide light filtering roller shades at all windows, unless noted otherwise.
  - 1. South Facing Rooms: Jamb mounted light filtering shades so top of shade aligns with the top of light shelf. Blackout shades to be installed at top of window opening.
  - 2. East, West and North Facing Rooms: Mount light filtering shades only at top of window opening.
  - 3. Install blackout shades on observation window within Soc Work 127 and on both doors 152B (Resource 152 side).
  - 4. Cafeteria 103: Install light filtering shades at six lowest windows on East face and two North face windows.
  - 5. Library 149: Install light filtering shades at four lowest.

END OF SECTION 122123

## SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Entrance carpet tiles.
- B. Related Sections include the following:
  - 1. Division 12 Section "Entrance Floor Grilles" for rigid foot grilles and frames.

## 1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Maintenance Data: For floor mats to include in maintenance manuals.

## 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain floor mats through one source from a single manufacturer.
- B. Accessibility Requirements: Provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

## PART 2 - PRODUCTS

## 2.1 ENTRANCE TILES (CPT-1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Recourse by Mannington or an approved substitution.
- B. Carpet-Type Tiles: Modular carpet tile with the following properties:
  - 1. Face Fiber: Type 6,6 Nylon.
  - 2. Dye Method: Solution dyed.
  - 3. Pile Characteristic: Pattern Textured-loop pile.
  - 4. Pile Average Height: 0.186 inches.

5. Stitches: 10.33 per inch.
6. Gage: 1/12.
7. Tufted Yarn Weight: 38.0 oz./sq. yd.
8. Backing System: Infinity™ RE.
9. Size: 24 by 24 inches.
10. Color: Traverse Tan.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and floor conditions for compliance with requirements for location, sizes, and other conditions affecting installation of floor mats and frames.
  1. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install surface-type units to comply with manufacturer's written instructions at locations indicated; coordinate with entrance locations and traffic patterns.

#### 3.3 PROTECTION

- A. Defer installation of floor mats until Project is near Substantial Completion.

END OF SECTION 124813

## SECTION 124816 - ENTRANCE FLOOR GRILLES

## 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 recessed foot grilles and frames.
- B. Related Sections include the following:
  - 1. Division 03 Section "Cast-in-Place Concrete" for slab depression grouting and filling for recessed foot grilles and frames.
  - 2. Division 12 Section "Entrance Floor Mats and Frames" for flexible floor mats and frames.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide foot grilles and frames capable of withstanding the following loads and stresses:
  - 1. Uniform floor load of 300 lbf/sq. ft..
  - 2. Wheel load of 350 lb per wheel.

## 1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for foot grilles and frames.
- B. Shop Drawings: Show the following:
  - 1. Items penetrating foot grilles and frames, including the following:
  - 2. Divisions between grille sections.
- C. Maintenance Data: For foot grilles and frames to include in maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain foot grilles and frames through one source from a single manufacturer.
- B. Accessibility Requirements: Provide installed foot grilles that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Indicate measurements on Shop Drawings.

## 1.7 COORDINATION

- A. Coordinate size and location of recesses in concrete to receive foot grilles and frames.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Safe Track by Mats, Inc. or a comparable product by one of the following:
  1. ARDEN Architectural Specialties, Inc.
  2. Balco, Inc.
  3. C/S Group.
  4. J. L. Industries, Inc.
  5. Kadee Industries, Inc.
  6. Pawling Corporation; Architectural Products Division.
  7. Reese Enterprises, Inc.

### 2.2 MATERIALS

- A. Extruded Aluminum: ASTM B 221, Alloy 6061-T6 or Alloy 6063-T5, T6, or T52 as standard with manufacturer. Coat surface of frame in contact with cementitious materials with manufacturer's standard protective coating.

### 2.3 FOOT GRILLES

- A. General: Provide manufacturer's standard foot-grille assemblies consisting of treads of type and profile indicated, interlocked or joined together by cross members, and with support legs (if any) and other components needed to produce a complete installation.
- B. Aluminum Foot Grilles: Provide manufacturer's standard foot grilles with extruded members, top-surfaced tread rails, and as follows:
  1. Tread Rails: Extruded-aluminum tread rails with extruded-aluminum frame.
  2. Tread Rail Spacing: 1-1/2 inches o.c. with 1/8- to 3/16-inch- wide openings between treads.
  3. Aluminum Finish: Mill.
  4. Grille Size: As indicated.

### 2.4 FRAMES

- A. Provide manufacturer's standard frames of size and style for grille type, for permanent recessed installation in subfloor, complete with installation anchorages and accessories. Unless otherwise indicated, fabricate frame of same material and finish as grilles.

## 2.5 SUPPORT SYSTEM

- A. Level Bed Applications: Provide manufacturer's standard, vinyl cushion support system.

## 2.6 FABRICATION

- A. Shop fabricate foot grilles to greatest extent possible in sizes as indicated. Unless otherwise indicated, provide each grille as a single unit; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in grilles are necessary, space symmetrically and away from normal traffic lanes.
- B. Fabricate frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

## 2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## 2.8 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Mill Finish: AA-M10 (Mechanical Finish: as fabricated); grind and buff as required to remove scratches, welding, or abrasions produced in fabrication process.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and floor conditions for compliance with requirements for location, size, minimum recess depth, and other conditions affecting installation of foot grilles and frames.
- B. Examine roughing-in for drainage piping systems to verify actual locations of piping connections before foot grille and frame and drain pan installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install recessed foot grilles and frames to comply with manufacturer's written instructions at locations indicated and with top of foot grilles and frames in relationship to one another and to adjoining finished flooring as recommended by manufacturer. Set foot-grille tops at height for most effective cleaning

action. Coordinate top of foot-grille surfaces with doors that swing across grilles to provide clearance under door.

### 3.3 PROTECTION

- A. After completing frame installations, provide temporary filler of plywood or fiberboard in foot-grille recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124816

## SECTION 126600 - TELESCOPING STANDS

## 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. Wall-attached telescoping stands.
- B. Related Sections include the following:
  - 1. Division 01 Section "Alternate Bid Items" for information on alternate pertaining to this section.

## 1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for telescoping stands.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Selection: For each type of exposed finish required.
- D. Operation and Maintenance Data: For telescoping stands to include in emergency, operation, and maintenance manuals.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Manufacturer's Engineering Responsibility: Preparation of data for telescoping stands, including Shop Drawings, and comprehensive engineering analysis by a qualified professional engineer.
- C. Safety Standard: Provide telescoping stands that comply with requirements in ICC 300.
- D. Welding: Qualify procedures and personnel according to AWS D1.1 "Structural Welding Code - Steel" and AWS D1.3 "Structural Welding Code - Sheet Steel."



- E. Accessibility Requirements: Provide telescoping stands that comply with requirements in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)".

## 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, and other construction that will interface with telescoping stands by field measurements before fabrication and indicate measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for telescoping stands is based on products of Hussey Seating Company. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
  1. Irwin Folding Bleacher Company.
  2. Sheridan Seating, Inc.

### 2.2 MATERIALS

- A. Wood:
  1. Lumber: Kiln-dried, surfaced four sides; southern pine complying with SPIB's "Standard Grading Rules for Southern Pine Lumber" for C&Btr Finish (C and better) grade-of-finish requirements.
  2. Plywood: APA grade trademarked, DOC PS 1.
- B. Steel:
  1. Structural Steel Shapes, Plates, and Bars: ASTM A 36/A 36M.
  2. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 coating designation.
  3. Uncoated Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold-rolled commercial steel), or ASTM A 1011/A 1011M, Designation CS (hot-rolled commercial steel).
  4. Tubing: ASTM A 500, cold formed; ASTM A 501, hot formed; or ASTM A 513, mechanical.
- C. Extruded Aluminum: ASTM B 221, alloy as standard for manufacturer.
- D. Polyethylene Plastic: High-density polyethylene; molded, color-pigmented, textured, impact-resistant, structural formulation.

### 2.3 TELESCOPING STANDS

- A. Description: Operable systems of multiple-tiered seating on interconnected folding platforms that close, without being dismantled, into a nested stack for storing or moving. Stand units permit opening and closing of adjacent rows, allow individual and collective rows to be locked open for use, and close with vertical faces of upper skirts on the same vertical plane.
- B. Wall-Attached Telescoping Stands: Rear of understructure permanently attaches to wall construction.

- C. Operation: Manual.
- D. Row Spacing: Fabricate units with first two row spacing of 26 inches and remaining row spacing of 24 inches, unless otherwise indicated.
- E. Row Rise: Fabricate units with row rise of between 9-5/8 and 10-1/2 inches, as standard with manufacturer.
- F. Bench Seats and Skirts:
  - 1. Material: Molded polyethylene plastic with contour seat surface Steel sheet with vinyl-clad finish Insert requirements.
    - a. Colors: As selected by Architect from manufacturer's standard.
  - 2. Bench Height: Not less than 16 inches or more than 18 inches.
  - 3. Bench Depth: 10 inches.
- G. Wheelchair Adaptation: Provide first row modular recoverable seating units to be utilized by persons in wheelchairs and able-bodied persons. Each Flex-Row unit shall have an unlock handle for easy deployment if wheelchair or team seating access is needed. Unlock handle shall lock the bleacher seats into position when fully opened.
  - 1. Provide a mechanical positive lock when the Flex-Row system is in the open and used position.
  - 2. Flex-Row modular units are designed to achieve multi-use front row seating to accommodate team seating, ADA requirements and facility specific requirements. Flex-Row units are available in modular units from 2 to 7 seats wide as well as full section width.
- H. Deck: Plywood.
  - 1. Finish: Transparent finish.
- I. Risers: Steel sheet with manufacturer's standard rust-inhibiting coating or hot-dip galvanized finish.
- J. Rails: Structural steel, finished with manufacturer's standard powder coat system.
  - 1. Color: Black.
- K. Understructure: Structural steel.
  - 1. Finish: Manufacturer's standard rust-inhibiting finish.
  - 2. Color: Manufacturer's standard.
- L. Support Column Wheels: Nonmarring, soft, rubber-face wheel assembly under each support column.
  - 1. Include wheels of size, number, and design required to support stands and operate smoothly without damaging the flooring surface, but not less than four per column or less than 5 inches in diameter and 4 inches wide for use with synthetic or wood flooring materials.
- M. Aisles: Fabricate stands with the following aisle configuration, at locations and of widths indicated:
  - 1. Footrest-Level Configuration: Interrupt seats to provide aisle walking surfaces at footrest level.
- N. Fasteners: Vibration proof, in manufacturer's standard size and material.

- O. Accessories:
1. Intermediate aisle steps, fully enclosed, at each vertical aisle.
  2. Transitional top step, fully enclosed, at each vertical aisle where last row of telescoping stands is adjacent to a cross aisle.
  3. Removable mid-aisle handrails located at centerline of each vertical aisle with seating on both sides.
  4. End rails (guards) that are telescoping and self-storing.
  5. Front railings of removable type along front footrest of stands where footrest is more than 24 inches above floor; at front of cross aisles located at front of stands or within stands; and at foot of vertical aisles where foot of the aisle is more than 30 inches above floor.
  6. Rear fillers including supports for closing openings between top row and rear wall of adjoining construction.
  7. Gap fillers for closing openings between stand units or between stand units and adjoining construction.
  8. Vinyl-End Curtains: Provide manufactures standard vinyl end curtains to close off under the bleacher units in the extended position. Curtain color to be selected from manufacturer's standard offering.

## 2.4 FABRICATION

- A. Fabricate understructure from structural steel members in size, spacing, and form required to support design loads specified in referenced safety standard.
1. Lower Track: Provide Continuous Positive Interglide System that interlocks each adjacent CPI unit using an integral, continuous, anti-drift feature and through-bolted gude at front to prevent separation and misalignment. CPI units at end section of powered banks and manual sections shall contain Low Profile Posi-Lock LX to lock each row in open positions and allow unlocking automatically. Provide adjustable stops to allow field adjustment of row spacings.
  2. Slant Columns: High tensile steel, tubular shape.
  3. Sway Bracing: High tensile steel members through-bolted to columns.
  4. Deck Stabilizer: High tensile steel member through-bolted to and riser at three locations per section. Interlocks with adjacent stabilizer on upper tier using low-friction nylon roller to prevent separation and misalignment. Incorporates multiple stops to allow field adjustment of row spacings.
  5. Deck Support: Securely capture front and rear edge of decking at rear edge of nose beam and lower edge or riser beam for entire length of section.
- B. Weld understructure to comply with applicable AWS standards.
- C. Round corners and edges of components and exposed fasteners to reduce snagging and pinching hazards.
- D. Form exposed sheet metal with flat, flush surfaces, level and true in line, and without cracking and grain separation.
- E. Seating Supports: Fabricate supports to withstand, without damage to components, the forces imposed by use of stands without failure or other conditions that might impair the usefulness of seating units.
1. Cantilever bench seat supports to produce toe space uninterrupted by vertical bracing.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine areas where telescoping stands are to be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

- A. Install telescoping stands to comply with referenced safety standard and manufacturer's written instructions.

## 3.3 ADJUSTING AND CLEANING

- A. On completion of installation, lubricate, test, and adjust each telescoping stand unit so that it operates according to manufacturer's written operating instructions.
- B. Clean installed telescoping stands on exposed and semiexposed surfaces. Touch up shop-applied finishes or replace components as required to restore damaged or soiled areas.

## 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain telescoping stands. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 126600

## SECTION 142400 - HYDRAULIC ELEVATORS

## 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 hydraulic passenger elevators.
- B. Related Sections include the following:
  - 1. Division 03 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
  - 2. Division 04 Section "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
  - 3. Division 05 Section "Metal Fabrications" for the following:
    - a. Attachment plates and angle brackets for supporting guide-rail brackets.
    - b. Hoist beams.
    - c. Structural-steel shapes for subsills.
    - d. Pit ladders.
  - 4. Division 26 Section "Electrical" for telephone service for elevators.
  - 5. Division 26 Section "Electrical" for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.
  - 6. Division 27 Sections for telephone service to elevators.
  - 7. Division 28 Sections for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

## 1.3 DEFINITIONS

- A. Definitions in ASME A17.1 apply to work of this Section.
- B. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

## 1.4 SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:

1. Car enclosures and hoistway entrances.
  2. Operation, control, and signal systems.
- B. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples for Selection: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch-square Samples of sheet materials; and 4-inch lengths of running trim members.
- D. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
- E. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- F. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- G. Warranty: Special warranty specified in this Section.
- H. Continuing Maintenance Proposal: Service agreement specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Regulatory Requirements: Design elevator system to meet the seismic risk zone as determined by the authority having jurisdiction, including building official and elevator inspector.
- C. Accessibility Requirements: Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
- D. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.
- E. The elevator installation shall be a design that can be maintainable by any licensed elevator maintenance company employing journeymen mechanics, without the need to purchase or lease additional diagnostic devices, special tools, or instructions from the original equipment manufacturer.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging.
- B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

## 1.7 COORDINATION

- A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.
- B. Furnish well casing and coordinate delivery with related excavation work.
- C. Coordinate sequence of elevator installation with other work to avoid delaying the Work.
- D. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.
- E. Coordinate size of elevator pit with manufacturer selected. Provide any necessary revisions to pit or shaft size at no additional cost to the Owner.

## 1.8 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.
  - 1. Warranty Period: One year from date of Substantial Completion.

## 1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide one year's full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.
  - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
    - a. Response Time: Two hours or less.
- B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Canton.
  2. Otis Elevator Co.
  3. ThyssenKrupp Elevator.

## 2.2 SYSTEMS AND COMPONENTS

- A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard pre-engineered elevator systems and as required for complete system.
- B. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations. Provide the following:
1. Submersible pump, with submersible squirrel-cage induction motor, suspended inside oil tank from vibration isolation mounts.
  2. Provide motor with solid-state starting.
  3. Provide variable-voltage variable-frequency motor control.
- C. Hydraulic Silencers: Provide hydraulic silencer containing pulsation-absorbing material in a blowout-proof housing at pump unit.
- D. Piping: Provide size, type, and weight piping recommended by manufacturer, and provide flexible connectors to minimize sound and vibration transmissions from power unit.
1. Provide dielectric couplings at cylinder units.
  2. Casing for Underground Piping: PVC pipe complying with ASTM D 1785 joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.
- E. Hydraulic Fluid: Nontoxic, readily biodegradable made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives. Hydraulic fluid is approved by elevator manufacturer for use with elevator equipment.
1. Product: Subject to compliance with requirements, provide "Hydro Safe" by Hydro Safe Oil Division, Inc.
- F. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.
- G. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1, of sufficient size to provide not less than 1-inch clearance from cylinder and extending above pit floor. Provide means to monitor casing effectiveness to comply with ASME A17.1.
- H. Corrosion Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler is electrically nonconductive, displaces or absorbs water, and gels or solidifies at temperatures below 60 deg F.



1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

- a. Hydro Safe Oil Division, Inc.; No-Ox-Id Liquid Elevator Casing Filler E-800.
- b. Union-Gard, a division of Dome Services L.L.C.; Union-Gard 160.

I. Car Frame and Platform: Welded steel units.

J. Guides: Provide either roller guides or sliding guides at top and bottom of car and counterweight frames. If sliding guides are used, provide guide-rail lubricators or polymer-coated, nonlubricated guides.

## 2.3 OPERATION SYSTEMS

A. General: Provide manufacturer's standard microprocessor operation system as required to provide type of operation system indicated.

B. Single-Car Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:

1. Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.

C. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated.

1. Independent Service: Keyswitch in car control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to the door close button.

## 2.4 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.

## 2.5 FINISH MATERIALS

A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

E. Stainless-Steel Bars: ASTM A 276, Type 304.

F. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.

G. Aluminum Extrusions: ASTM B 221, Alloy 6063.

- H. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications.

## 2.6 CAR ENCLOSURES

- A. General: Provide steel-framed car enclosures with nonremovable wall panels, with car roof, access doors, power door operators, and ventilation.
  - 1. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
  - 2. Provide finished car including materials and finishes specified below.
- B. Materials and Finishes: Provide manufacturer's standards, but not less than the following:
  - 1. Subfloor: Underlayment grade, exterior plywood, 5/8-inch nominal thickness.
  - 2. Floor Finish: Floor finish by others.
  - 3. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to 1/2-inch fire-retardant-treated particleboard with plastic-laminate panel backing and manufacturer's standard protective edge trim. Panels have a flame-spread index of 25 or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected by Architect from plastic-laminate manufacturer's full range.
  - 4. Fabricate car with recesses and cutouts for signal equipment.
  - 5. Fabricate car door frame integrally with front wall of car.
  - 6. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
  - 7. Sight Guards: Provide sight guards on car doors.
  - 8. Sills: Extruded metal, with grooved surface, 1/4 inch thick.
  - 9. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
  - 10. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

## 2.7 HOISTWAY ENTRANCES

- A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.
  - 1. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.
- B. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
  - 1. Enameled-Steel Frames: Formed from cold-rolled or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
  - 2. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
  - 3. Sight Guards: Provide sight guards on doors matching door edges.
  - 4. Sills: Extruded metal, with grooved surface, 1/4 inch thick.
  - 5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

## 2.8 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with long-life incandescent lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers.
- B. Car Control Stations: Provide manufacturer's standard semirecessed car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.
- C. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 28 Section "Fire Detection and Alarm."
- E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
  - 1. Include travel direction arrows if not provided in car control station.
- F. Hall Push-Button Stations: Provide hall push-button stations at each landing as indicated.
  - 1. Provide manufacturer's standard wall-mounted units.
  - 2. Provide units with flat faceplate for mounting with body of unit recessed in wall.
  - 3. Equip units with buttons for calling elevator and for indicating desired direction of travel.
- G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide the following:
  - 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
- H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
- I. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above hoistway entrance at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall.
  - 1. Integrate ground-floor hall lanterns with hall position indicators.
- J. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

## 2.9 ELEVATOR

## A. Elevator Description:

1. Type: Under-the-car single cylinder.
2. Rated Load: 4500 lb.
3. Rated Speed: 100 fpm.
4. Number of Stops: 2
5. Vertical Rise: 14'-8"
6. Front Openings: 2
7. Rear Openings: 0
8. Operation System: Single automatic operation.
9. Car Enclosures:
  - a. Inside Width: Manufacturer's standard from side wall to side wall.
  - b. Inside Depth: Manufacturer's standard from back wall to front wall (return panels).
  - c. Inside Height: Manufacturer's standard to underside of ceiling.
  - d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
  - e. Car Fixtures: Satin stainless steel, No. 4 finish.
  - f. Side and Rear Wall Panels: Plastic laminate.
  - g. Reveals: Enameled steel.
  - h. Door Faces (Interior): Enameled steel.
  - i. Door Sills: Aluminum, mill finish.
  - j. Ceiling: Luminous ceiling.
  - k. Handrails: 1/2 by 2 inches rectangular satin stainless steel, No. 4 finish, at sides and rear of car.
  - l. Floor: Finish flooring by others.
10. Hoistway Entrances:
  - a. Width: 48 inches.
  - b. Height: 84 inches.
  - c. Type: Two-speed side sliding.
  - d. Fire-Protection Rating: 1-1/2 hours.
  - e. Frames: Enameled steel.
  - f. Doors: Enameled steel.
  - g. Sills: Aluminum, mill finish.
11. Hall Fixtures: Satin stainless steel, No. 4 finish.
12. Additional Requirements:
  - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
  - b. Provide blanket hooks and one complete set of full-height protective blankets.
13. Electrical Requirements:
  - a. 30 hp.
  - b. 480V 3-phase.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
  - 1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

- A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby eliminate sources of structure-borne noise from elevator system.
- D. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cemented fittings.
- E. Install piping above the floor, where possible. Where not possible, cover underground piping with permanent protective wrapping before backfilling.
- F. Lubricate operating parts of systems as recommended by manufacturers.
- G. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- H. Leveling Tolerance: 1/4 inch, up or down, regardless of load and direction of travel.
- I. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- J. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
  - 1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
  - 2. Place hall lanterns either above or beside each hoistway entrance.
  - 3. Mount hall lanterns at a minimum of 72 inches above finished floor.

### 3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.
- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

### 3.4 PROTECTION

- A. Temporary Use: Temporary use is not allowed.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s). Refer to Division 01 Section "Demonstration and Training."
- B. Check operation of elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.
- C. Check operation of elevator with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 142400

## **FIRE PROTECTION:**

1. **Sprinkler System** - Building shall be provided with sprinkler system in accordance with NFPA 13. Sprinkler heads in areas with finished ceilings shall be recessed with matching escutcheon plates or sidewall heads. Heads in areas where structure is exposed shall be brass upright sprinklers on exposed piping. Sprinkler system shall be tied into Fire Alarm System to indicate alarm or trouble condition. PWD conducted hydrant flow test. The flow test data results are adequate for providing sprinkler protection within the building to satisfy NFPA 13 without a fire pump and meet City requirement of 1375 GPM at 20 psi residual referenced Uniform Fire Code Annex H & J as required.
2. **Standpipe Systems** - Sprinkler system standpipes will be provided in classroom wing stairwells. Standpipe requirements and type shall be in accordance with NFPA 14. Standpipes preferred shall be manual wet systems as available water supply would not support standpipe system.

## **PLUMBING:**

1. **Plumbing Fixtures** - All water closets, urinals and lavatories in public spaces shall be vitreous china fixtures with water conserving valves and control devices. Water closets and urinals shall be equipped with flushometer valves. Floor mounted mop sinks with faucets shall be provided in janitor closets. Exterior frost proof, self-draining hose hydrants along building exterior perimeter of building shall be provided at service doors for general use. Different fixtures types for public and staff areas if desired.
  - a. Preferred Water Closets type: Kohler or American Standard with Sloan valves
    - i. Wall mounted with blow-out action and manual flush valve.
    - ii. Automatic flush valve possible at common area restrooms.
  - b. Preferred Urinal type: Sloan or Zurn
    - i. Ultra-low flow (1/8 GPF "a pint")
    - ii. Manual flush valve
  - c. Preferred Lavatories: Kohler or American Standard with Chicago Faucets
    - i. Wall hung w/ plastic base shrouds
    - ii. Automatic faucets. Low profile type preferred.
  - d. Preferred Classroom Sinks
    - i. Stainless steel drop in counter mount type, with bubbler and 8" gooseneck manual faucet. John Nueslein to provide specs for preferred bubbler.
  - e. Showers:
    - i. Fiberglass units in the clinic
    - ii. Field built, tile enclosures in the locker rooms
    - iii. Mixing valves at showers of main building tempered water system Preferred shower valve Symmons S96-1,

- f. Clothes Washer/Dryers:
    - i. Provide clothes washer and dryer connections in the following:
      - 1. Functional Life Skills (FLS) area only.
  - g. Emergency Eyewash Equipment:
    - i. Eyewash stations shall be either wall mount or swing away type. Owner's preference is Guardian Equipment.
    - ii. Eyewash stations shall be provided in the following locations:
      - 1. Mechanical / Boiler Rooms.
      - 2. Art Room.
      - 3. Clinic.
2. **Domestic Water Service Entrance** – Municipal water service is adequate and available at site. Current water pressure available is 85 psi at Walton Street. New service shall include backflow prevention device and meter assembly as required by Portland Water District. Available water pressure is such that neither a booster pump nor pressure-reducing valve is required.
3. **Domestic Water Distribution System** - All new domestic water piping shall be type "L" copper with lead-free soldered fittings or mechanical joints approved for domestic water applications. Piping system to be provided with appropriate hanging and anchoring devices to allow for adequate structural support, expansion and contraction movement. Branches and individual fixtures shall be provided with isolation valves for maintenance and service. All domestic water piping shall be insulated with pipe insulation in accordance with ASHRAE 90. All domestic cold-water piping shall be insulated to prevent condensation. Provide isolation valves by floors, wings and at groups of plumbing fixtures. Provide pipe labels (type and direction) and valve tags for all piping systems.
4. **Domestic Hot Water System** - Domestic hot water system shall be provided for general-purpose use and Kitchen demand. Domestic water heaters shall be indirect fired, storage type, utilizing boiler water as heating source. A gas fired water heater sized for the summer load will be considered. A Solar domestic water heating system consisting of roof mounted solar collectors, heat-exchanger/tank, glycol loop, pump and controls, will be provided for the summer load. Domestic hot water will be stored at 140 deg F. A Symmons mixing valve (set for 105 def F delivery) shall be provided for domestic water line serving all plumbing fixtures except kitchen area. Dedicated mixing valve (set for 115-120 deg F) and supply piping shall be provided to serve the provided to kitchen fixtures. Facilities personnel indicated that 140 deg F water is not required at the Kitchen due to the cleaning chemicals that are used. Domestic hot water recirculation loops with individual area balancing valves shall be provided along main piping runs. All domestic hot water piping shall be insulated with fiberglass pipe insulation. Heat Trace is not preferred and will not be provided.



5. **Drainage System** - Building drainage, waste and vent piping shall be Schedule 40 PVC with solvent welded fittings or heavy weight cast iron with hub and spigot fittings. All drainage piping below grade shall be Schedule 40 PVC. Condensate drainage shall be provided for HVAC equipment. Floor drains shall be provided in public toilet rooms, service spaces, and mechanical spaces. Floor drains shall be provided with trap primers. Electronic Trap Primers are preferred and will be provided.
6. **Rain Water System** - Building roof drain piping shall be Schedule 40 PVC insulated piping with solvent welded fittings. Roof drains shall be provided at all low points in roofing system. Roof drains shall be cast iron drains with cast iron or aluminum dome strainers. Overflow roof drains shall be provided in addition to standard roof drains to prevent water accumulation if primary drains fail. Overflow piping shall be piping separate from rainwater piping and shall exit building near grade. A placard shall be provided at outlet to indicate if water is exiting these drains to call emergency number provided. All rain water piping (including overflow piping) shall be insulated with 1” thick fiberglass insulation with ASJ sealed to provide vapor barrier to prevent condensation.

#### **HEATING, VENTILATION AND AIR CONDITIONING:**

1. **General:**
  - a. Intent is minimal roof mounted equipment.
  - b. 36” high air intakes will be provided for any roof mounted equipment.
  - c. Air intakes preferred utilizing roof hoods or wall louvers will be provided to maintain maximum separation.
2. **Sustainability** – Heating and Ventilation system shall be designed to meet or exceed energy requirements as required by “Benchmark”. H & V system shall be provided with equipment exceeding the minimum efficiencies and shall provide energy management system as required to provide monitoring and trending of system performance. Extent needs to be reviewed and determined prior to start of design process.
3. **Boiler Plant** – Boiler plant shall consist of two hot water boilers each sized for approximately 60% of heating design loads. Boilers shall be horizontal firetube boilers (Cleaver-Brooks). Boiler combustion and ventilation air shall be provided in accordance with NFPA 31.
  - a. The existing boiler within the existing building on the existing project site will not be used for the new School Facility. The boiler will be salvaged by the district for possible use elsewhere.
4. **Fuel Systems** – Dual fuel system utilizing No. 2 fuel oil and natural gas shall be provided.
  - a. No. 2 Fuel oil storage tank shall be underground double wall fiberglass with monitoring equipment and all components as required for installation in

accordance with DEP requirements. Tank size to be determined. A duplex transfer pump set and day tank shall be provided within boiler room to deliver fuel oil to the boilers. Underground piping shall consist of supply and return piping equal to Environ double wall system and approved by DEP. Facilities personnel indicated the concrete pad must be crowned.

- b. Natural Gas service shall be provided and coordinated with the Utility, civil engineer, and site utility plans.
    - i. Piping shall be distributed to the Boiler Room, size and pressure to be determined.
    - ii. The warming kitchen appliances to be electric per Owner.
    - iii. There are no Science Rooms in the program that require natural gas service.
5. **Hot Water Distribution System** - Heating distribution shall be hot water system with heating pumps provided in a lead/lag arrangement. Each pump shall be provided with variable frequency drives on premium efficiency motors to reduce energy consumption. Lag pump shall start upon failure of lead pump. Lead and Lag pumps shall cycle on a programmed schedule to operate each pump as the lead pump. Hot water distribution system shall consist of either Schedule 40 black iron piping or Type L copper tubing. All piping larger than 2" shall be black iron pipe with welded fitting and joints. Piping 2" and smaller shall be soldered copper or black iron pipe with threaded fittings. Hot water piping shall be provided to all heating coils within air handling equipments, reheat coils and terminal units. Provide pipe labels (type and direction) and valve tags for all piping systems.
6. **Heating and Ventilation Systems** – Systems shall consist of indoor air handling units located within mechanical mezzanine space. Air handling units shall be provided with energy recovery wheel to preheat outside ventilation air from exhaust air stream. Ventilation air shall be provided within the heating and air conditioning systems and shall be conditioned as required to maintain room temperature setting and occupant comfort. Ventilation system shall use CO2 monitors to maintain indoor air quality requirements with minimum ventilation outdoor air. Equipment shall be based on Trane w/ Carrier and McQuay as options to have minimum 3 acceptable manufacturers. Owner's Preference is not to use York equipment.
- a. Air Systems types shall be:
    - i. Classrooms: Displacement System and Radiant Heating Ceiling Panels.
    - ii. Areas with Mechanical Cooling: Mixed air systems, variable-air-volume with overhead supply air distribution.
    - iii. Gym, Cafeteria: Heating and Ventilating only, mixed air systems with overhead supply air distribution.

All classrooms will have individual thermostatic controls and occupancy sensors.

7. **Air Distribution:** All ductwork to be constructed in accordance with SMACNA standards. All supply and outside make-up air ductwork systems to receive duct insulation.
8. **Air Conditioning System:** Mechanical cooling (air conditioning) shall be provided in limited areas. Air handling units shall be provided with economizer operation to allow for cooling with use of outside air when outside air conditions are below indoor air temperatures. Portions of the facility will be used year round.
  - i. A chilled water system shall be provided. Size to be determined. Chiller shall be packaged air-cooled type with multiple compressors and utilize either R-407C or R-410A refrigerant. Preferred chiller location is at grade adjacent to the Boiler Room to minimize noise to core learning spaces and allow easy access for maintenance. Chilled water piping shall distributed above grade parallel to the heating piping mains to the air handling units with cooling coils. Pumps shall be located in the Boiler Room or Second Floor space above the Boiler Room.
  - b. Areas to be provided with air conditioning:
    - i. Offices (zoned independently served by common Air handler with FLS spaces)
    - ii. Library (zoned independently served by common Air handler with FLS spaces)
    - iii. Computer Rooms
    - iv. Main telephone/Data closets (dedicated mini-split AC units)
    - v. Functional Life Skills area , FLS
    - vi. Provisions for future air conditioning shall be included.
9. **Food Service:** A full service kitchen is not planned for this facility. Food service operations limited to warming, prep, and serving. A range/oven is planned. A commercial kitchen hood, dedicated roof mounted exhaust fan and fire suppression system shall be provided.
10. **Temperature Controls/Energy Management System:** System controls shall be direct digital controls (DDC) to provide for total building automated controls with offsite monitoring and control capabilities. System will control various HVAC systems and provide for occupied and unoccupied control of various spaces and zones. System shall be capable to monitor and trend system performance and alarm conditions. Web based system DDC system is preferred. The School district currently uses several HVAC control vendors. Control specification to be open and include; Johnson Controls, Honeywell, Siemens, and TAC/IA (Maine Controls).
11. **Testing, Adjusting and Balancing:** All water and air systems shall be tested, adjusted, and balanced at project completion. All TAB operations shall be coordinated with commissioning agent TAB shall be independent agency, not be provided by installing company.

## 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.
- B. SUMMARY
- C. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Sleeves.
  - 3. Escutcheons.
  - 4. Supports and anchorages.
- D. Related Sections:
  - 1. Division 21 Section "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
  - 2. Division 21 Section "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment".

## 1.2 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.

## 1.3 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.
- C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- 1.4 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.
- 1.5 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.
- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

## PART 2 - PRODUCTS

- 2.1 PIPE, TUBE, AND FITTINGS
- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- 2.2 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 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 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.

- D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

### 2.3 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, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

## PART 3 - EXECUTION

### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. 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.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. 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.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- 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. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
  - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
  - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
  - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
  - f. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
  - g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

K. Sleeves are not required for core-drilled holes.

L. Install sleeves for pipes passing through concrete and masonry walls and concrete floors.

M. 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 "Penetration Firestopping" for materials.

### 3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections 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. 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 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. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.3 PAINTING

A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting"

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

## 3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

## 3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

END OF SECTION 210500



## SECTION 210548 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION 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. This Section includes the following:

- 1. Reference.

## 1.3 DEFINITIONS

- A. ASCE: American Society of Civil Engineers.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Design Criteria:

- 1. Fire Suppression Piping and Equipment components are exempt from the requirements of ASCE 7 Chapter 13 Seismic Design for Nonstructural Components.
- 2. Refer to Structural General Notes Sheet S001.
- 3. Building Occupancy Category: III
- 4. Site Class: D
- 5. Seismic Design Category: B

## 1.5 SUBMITTALS

- A. None.

PART 2 - PRODUCTS

2.1 None

PART 3 - EXECUTION

3.1 None.

END OF SECTION 210548

## SECTION 211200 - FIRE-SUPPRESSION STANDPIPES

## 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 valves.
  - 3. Hose connections.
  - 4. Fire-department connections.
  - 5. Alarm devices.
  - 6. Manual control stations.
- B. Related Sections:
  - 1. Division 21 Section "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.

## 1.3 DEFINITIONS

- A. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig maximum.

## 1.4 SYSTEM DESCRIPTIONS

- A. Manual Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has small water supply to maintain water in standpipes. Piping is wet, but water must be pumped into standpipes to satisfy demand.

## 1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig 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. Hydrant Flow Test Data: Refer to Sheet FX101.
- D. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.

## 1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, 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 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- F. Operation and Maintenance Data: For fire-suppression standpipes 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 fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
    - a.
    - b. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer or NICET Level III.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. 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.
- D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

## 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, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

- B. Standard-Weight, Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, seamless steel pipe with threaded ends.
- C. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
- D. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME B16.1, Class 125.
- G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- H. Grooved-Joint, Steel-Pipe Appurtenances:
  - 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. Corcoran Piping System Co.
    - c. National Fittings, Inc.
    - d. Shurjoint Piping Products.
    - e. Tyco Fire & Building Products LP.
    - f. Victaulic Company.
  - 2. Pressure Rating: 175 psig minimum.
  - 3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
  - 4. 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: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
  - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

### 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.
- B. 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:
    - a. AFAC Inc.
    - b. Crane Co.; Crane Valve Group; Crane Valves.
    - c. Fire Protection Products, Inc.

- d. Globe Fire Sprinkler Corporation.
  - e. Metraflex, Inc.
  - f. Milwaukee Valve Company.
  - g. Mueller Co.; Water Products Division.
  - h. NIBCO INC.
  - i. Shurjoint Piping Products.
  - j. Tyco Fire & Building Products LP.
  - k. Victaulic Company.
  - l. Viking Corporation.
- 2. Standard: UL 312.
  - 3. Pressure Rating: 250 psig minimum.
  - 4. Type: Swing check.
  - 5. Body Material: Cast iron.
  - 6. End Connections: Flanged or grooved.

## 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 minimum.

## 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. Pressure Rating:
  - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
- 3. Body Material: Cast or ductile iron.
- 4. Size: Same as connected piping.
- 5. End Connections: Flanged or grooved.

## 2.7 HOSE CONNECTIONS

### A. Nonadjustable-Valve Hose Connections:

- 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. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. Fire Protection Products, Inc.
  - d. Guardian Fire Equipment, Inc.
  - e. Kennedy Valve; a division of McWane, Inc.
  - f. Mueller Co.; Water Products Division.
  - g. NIBCO INC.
  - h. Tyco Fire & Building Products LP.
- 2. Standard: UL 668 hose valve for connecting fire hose.
- 3. Pressure Rating: 300 psig minimum.
- 4. Material: Brass or bronze.
- 5. Size: NPS 2-1/2 w/ NPS 1-1/2 reducer
- 6. Inlet: Female pipe threads.

7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Angle.
9. Finish: Polished chrome plated.

## 2.8 FIRE-DEPARTMENT CONNECTIONS

- A. Exposed-Type, Fire-Department Connection:
  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. AFAC Inc.
    - b. Elkhart Brass Mfg. Company, Inc.
    - c. Guardian Fire Equipment, Inc.
    - d. Tyco Fire & Building Products LP.
  2. Standard: UL 405.
  3. Type: Exposed, projecting, for wall mounting.
  4. Pressure Rating: 175 psig minimum.
  5. Body Material: Corrosion-resistant metal.
  6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and 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: 1 - 4" Storz.
  11. Escutcheon Plate Marking: Similar to "STANDPIPE."
  12. Finish: Rough brass or bronze.
  13. Outlet Size: NPS 4.

## 2.9 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated finish with set-screws.
- C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.

## 2.10 SLEEVES

- A. Cast-Iron Wall-Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  1. Underdeck Clamp: Clamping ring with set-screws.

## 2.11 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: Stainless 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 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
  
- B. Report test results promptly and in writing.

#### 3.2 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
  
- B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
  
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
  
- B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.
  
- C. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
  
- D. Install drain valves on standpipes. Extend drain piping to outside of building.



- E. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.
- F. Install alarm devices in piping systems.
- G. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.
- H. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 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.
- I. Fill wet-type standpipe 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 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water 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, 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.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-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 grooved joints.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 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 14 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.

### 3.6 HOSE-CONNECTION INSTALLATION

- A. Install hose connections adjacent to standpipes.
- B. Install freestanding hose connections for access and minimum passage restriction.
- C. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device.

### 3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

### 3.8 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.

### 3.9 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- D. Install sleeves in new partitions, slabs, and walls as they are built.

- E. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- F. For exterior wall penetrations above grade, seal annular space between sleeve 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."
- G. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- H. Seal space outside of sleeves in concrete slabs and walls with grout.
- I. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- J. Install sleeve materials according to the following applications:
  - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.
  - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
    - a. Extend sleeves 2 inches above finished floor level.
    - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."
  - 3. Sleeves for Piping Passing through Concrete Roof Slabs: Galvanized-steel pipe.
  - 4. Sleeves for Piping Passing through Exterior Concrete Walls:
    - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
    - b. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
  - 5. Sleeves for Piping Passing through Interior Concrete Walls:
    - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
- K. 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 "Penetration Firestopping."

### 3.10 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.

### 3.11 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

## 3.12 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

## 3.13 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Standard-pressure, wet-type, fire-suppression standpipe piping, NPS 4 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 roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

END OF SECTION 211200

## 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 valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Pressure gages.

## B. Related Sections:

1. Division 21 Section "Common Work results for Fire Suppression".
2. Division 21 Section "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment".
3. Division 28 Section "Digital, Addressable Fire-Alarm System" for alarm devices not specified in this Section.

## 1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

## 1.4 SYSTEM DESCRIPTIONS

- A. Suppression System Water Supply: Public Water Supply.
- B. 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 melts fusible link or destroys frangible device. Hose connections are included if indicated.

## 1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig 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. Hydrant Flow Test Data: Refer to Sheet FX101
  2. Margin of Safety for Available Water Flow and Pressure: 20 percent, including losses through water-service piping and valves.
  3. Sprinkler Occupancy Hazard Classifications:
    - a. Building Service Areas: Ordinary Hazard, Group 1.
    - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - c. General Storage Areas: Ordinary Hazard, Group 1.
    - d. Libraries except Stack Areas: Light Hazard.
    - e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    - f. Office and Public Areas: Light Hazard.
    - g. Gymnasium: Ordinary Hazard, Group 2.
  4. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
    - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
  5. Maximum Protection Area per Sprinkler: Per UL listing.
  6. Maximum Protection Area per Sprinkler: Per NFPA 13.
  7. Total Combined Hose-Stream Demand Requirement: Per NFPA 13.

#### 1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
  1. Wiring Diagrams: For power, signal, and control wiring.
- 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. State of Maine, Fire Marshal's permit of approval.
- E. Welding certificates.
- F. 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 the requirements of NFPA 13, and State of Maine Fire Marshal's Office.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified NICET Level III or State of Maine Licensed Professional Engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. 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.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

## 1.8 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

## 1.9 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 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.
- D. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- E. Uncoated, Steel Couplings: ASTM A 865, threaded.
- F. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- G. Malleable- or Ductile-Iron Unions: UL 860.
- H. Cast-Iron Flanges: ASME 16.1, Class 125.
- I. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- J. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- K. Grooved-Joint, Steel-Pipe Appurtenances:
  - 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. Corcoran Piping System Co.
    - c. National Fittings, Inc.
    - d. Shurjoint Piping Products.
    - e. Tyco Fire & Building Products LP.
    - f. Victaulic Company.
  - 2. Pressure Rating: 175 psig minimum.
  - 3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
  - 4. 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: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
  - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

### 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.
- B. 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. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Global Safety Products, Inc.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Shurjoint Piping Products.
  - h. Tyco Fire & Building Products LP.
  - i. Victaulic Company.
  - j. Watts Water Technologies, Inc.
- C. Ball Valves:
1. Standard: UL 1091 except with ball instead of disc.
  2. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
  3. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
  4. Valves NPS 3: Ductile-iron body with grooved ends.
- D. Bronze Butterfly Valves:
1. Standard: UL 1091.
  2. Pressure Rating: 175 psig.
  3. Body Material: Bronze.
  4. End Connections: Threaded.
- E. Iron Butterfly Valves:
1. Standard: UL 1091.
  2. Pressure Rating: 175 psig.
  3. Body Material: Cast or ductile iron.
  4. Style: Lug or wafer.
  5. End Connections: Grooved.
- F. Check Valves:
1. Standard: UL 312.
  2. Pressure Rating: 250 psig minimum.
  3. Type: Swing check.
  4. Body Material: Cast iron.
  5. End Connections: Flanged or grooved.
- G. Bronze OS&Y Gate Valves:
1. Standard: UL 262.
  2. Pressure Rating: 175 psig.
  3. Body Material: Bronze.
  4. End Connections: Threaded.

## H. Iron OS&amp;Y Gate Valves:

1. Standard: UL 262.
2. Pressure Rating: 250 psig minimum.
3. Body Material: Cast or ductile iron.
4. End Connections: Flanged or grooved.

## I. Indicating-Type Butterfly Valves:

1. Standard: UL 1091.
2. Pressure Rating: 175 psig minimum.
3. Valves NPS 2 and Smaller:
  - a. Valve Type: Ball or butterfly.
  - b. Body Material: Bronze.
  - c. End Connections: Threaded.
4. Valves NPS 2-1/2 and Larger:
  - a. Valve Type: Butterfly.
  - b. Body Material: Cast or ductile iron.
  - c. End Connections: Flanged, grooved, or wafer.
5. Valve Operation: Integral electrical, 115-V ac, prewired, two-circuit, supervisory switch visual indicating device.

## J. NRS Gate Valves:

1. Standard: UL 262.
2. Pressure Rating: 250 psig minimum.
3. Body Material: Cast iron with indicator post flange.
4. Stem: Nonrising.
5. End Connections: Flanged or grooved.

## 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 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. Conbraco Industries, Inc.; Apollo Valves.
- b. Milwaukee Valve Company.
- c. NIBCO INC.
- d. Potter Roemer.
- e. Red-White Valve Corporation.
- f. Tyco Fire & Building Products LP.
- g. Victaulic Company.
- h. Watts Water Technologies, Inc.

D. Globe 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.

E. Plug 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. Southern Manufacturing Group.

## 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. Pressure Rating:
  - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
- 3. Body Material: Cast or ductile iron.
- 4. Size: Same as connected piping.
- 5. End Connections: Flanged or grooved.

B. Alarm 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. AFAC Inc.
  - b. Globe Fire Sprinkler Corporation.
  - c. Reliable Automatic Sprinkler Co., Inc.
  - d. Tyco Fire & Building Products LP.
  - e. Venus Fire Protection Ltd.
  - f. Victaulic Company.
  - g. Viking Corporation.
- 2. Standard: UL 193.
- 3. Design: For horizontal or vertical installation.

4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Standard: UL 1726.
2. Pressure Rating: 175 psig minimum.
3. Type: Automatic draining, ball check.
4. Size: NPS 3/4.
5. End Connections: Threaded.

## 2.7 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

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. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. GMR International Equipment Corporation.
  - d. Guardian Fire Equipment, Inc.
  - e. Potter Roemer.
2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal.
11. Escutcheon Plate Marking: Similar to " AUTO SPKR."
12. Finish: Rough brass or bronze.

## 2.8 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Standard: UL 213.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-T and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, plain-end pipe, or threaded.

**B. Flow Detection and Test Assemblies:**

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

**C. Branch Line Testers:**

1. Standard: UL 199.
2. Pressure Rating: 175 psig.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

**D. Sprinkler Inspector's Test Fittings:**

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

**E. Adjustable Drop Nipples:**

1. Standard: UL 1474.
2. Pressure Rating: 250 psig minimum.
3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
4. Size: Same as connected piping.
5. Length: Adjustable.
6. Inlet and Outlet: Threaded.

**F. Flexible, Sprinkler Hose Fittings:**

1. Standard: UL 1474.
2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
3. Pressure Rating: 175 psig minimum.
4. Size: Same as connected piping, for sprinkler.

**2.9 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. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.

6. Victaulic Company.
7. 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 minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler types, features, and options as follows:

1. Concealed ceiling sprinklers, including cover plate.
2. Extended-coverage sprinklers.
3. Pendent sprinklers.
4. Pendent, dry-type sprinklers.
5. Quick-response sprinklers.
6. Recessed sprinklers, including escutcheon.
7. Upright sprinklers.

E. Sprinkler Finishes:

1. Brass.
2. Bronze.
3. Painted.

F. Special Coatings:

1. Wax.
2. Lead.
3. Corrosion-resistant paint.

G. Sprinkler Escutcheons: Materials, types, and finishes for sprinklers head escutcheons are specified with sprinklers.

## 2.10 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

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. Globe Fire Sprinkler Corporation.
  - b. Tyco Fire & Building Products LP.
  - c. Victaulic Company.
  - d. Viking Corporation.

2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 10-inch diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4.
8. Outlet: NPS 1 drain connection.

C. Water-Flow Indicators:

1. Standard: UL 346.
2. Water-Flow Detector: Electrically supervised.
3. 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.
4. Type: Paddle operated.
5. Pressure Rating: 250 psig.
6. Design Installation: Horizontal or vertical.

D. 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. Fire-Lite Alarms, Inc.; a Honeywell company.
  - b. Kennedy Valve; a division of McWane, Inc.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell 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.

E. Tank Liquid Leveling Sensors and Alarms:

1. 120V ac. Provide enclosure with trouble lamps and local alarm. Provide contacts for remote alarm "trouble" to fire alarm system.
2. Provide tank liquid level devices to sense the following conditions;
  - a. Critical Low Level.
  - b. Critical High Level.
3. Alarm conditions to initiate the following;
  - a. On low or high liquid level conditions, initiate trouble alarm monitored by the fire alarm system.
  - b. On low or high liquid level conditions to initiate tank monitoring panel lamps. Provide lamp for each condition.

2.11 PRESSURE GAGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- C. Pressure Gage Range: 0 to 250 psig minimum.

- D. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- E. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

## 2.12 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with set-screws.
- C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw or spring clips.
- E. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with concealed hinge and set-screw.
- F. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed hinge, set-screw or spring clips.
- G. One-Piece Floor Plates: Cast-iron flange.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

## 2.13 SLEEVES

- A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.
  - 1. Underdeck Clamp: Clamping ring with set-screws.

## 2.14 SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Sealing Elements: EPDM-rubber 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: Stainless steel of length required to secure pressure plates to sealing elements.

## PART 3 - EXECUTION

### 3.1 PREPARATION



- A. Refer to Division 31 Earthwork, for excavating, trenching, and backfilling.
- B. Refer to Division 31 Earthwork, for exterior piping, buried fire storage tanks, and accessories.

### 3.2 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to facility water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Facility Water Distribution Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with local water department requirements."

### 3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating 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 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 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 automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- L. 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 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.
- M. 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 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water 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. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
  - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- J. 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.
- K. Steel-Piping, Roll-Grooved Joints: Roll rounded-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 grooved joints.
- L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 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 center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

### 3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

### 3.8 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 stamped steel with set-screw or spring clips.
  - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split casting, cast brass with polished chrome-plated finish.
  - 4. Bare Piping in Unfinished Service Spaces: One piece, stamped steel with set-screw or spring clips.
  - 5. Bare Piping in Equipment Rooms: One piece, stamped steel with set-screw or spring clips.
  - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

### 3.9 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes, except in Mechanical Mezzanines.
- C. Cut sleeves to length for mounting flush with both surfaces, except in Mechanical Mezzanines..
- D. Install sleeves in new partitions, slabs, and walls as they are built.

- E. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- F. For exterior wall penetrations above grade, seal annular space between sleeve 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."
- G. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- H. Seal space outside of sleeves in concrete slabs and walls with grout.
- I. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- J. Install sleeve materials according to the following applications:
  - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.
  - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
    - a. Extend sleeves 2 inches above finished floor level.
  - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
    - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
    - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
    - c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
  - 4. Sleeves for Piping Passing through Exterior Concrete Walls:
    - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
    - b. Cast-iron wall-pipe sleeves for pipes NPS 6 and larger.
    - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
- K. 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 "Penetration Firestopping."

### 3.10 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.

### 3.11 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 Section "Identification for Electrical Systems."

### 3.12 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.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Start and run excess-pressure pumps.
  - 6. Coordinate with fire-alarm tests. Operate as required.
  - 7. Coordinate with fire-pump tests. Operate as required.
  - 8. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.13 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

### 3.14 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

### 3.15 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-pressure, wet-pipe sprinkler system, NPS 2 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.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 6, 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 cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
4. Thinwall black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

### 3.16 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Recessed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Pendent, dry sprinklers.
5. Exterior Canopy with Ceilings: Recessed sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Interior Exposed Piping: Plain brass finished sprinkler heads.
2. Recessed Sprinklers (SAT & GWB Ceilings): White finished sprinkler heads and escutcheons.
3. Recessed Sprinklers (Wood Slat Ceilings): Rough brass finished sprinkler heads and escutcheons.
4. Exterior Canopy Ceiling Recessed Sprinklers: Plain bronze finished sprinklers and escutcheons with corrosive resistant finish.

END OF SECTION 211313

## 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 RELATED SECTIONS

- A. Division 1 Section 019113 "General Commissioning Requirements".

## 1.3 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. Sleeves.
  - 5. Escutcheons.
  - 6. Plumbing demolition.
  - 7. Equipment installation requirements common to equipment sections.
  - 8. Supports and anchorages.

## 1.4 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. PVC: Polyvinyl chloride plastic.

### 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Transition fittings.
  - 2. Dielectric fittings.
  - 3. Escutcheons.

### 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.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

### 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 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."

## 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.

## 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining 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. 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 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 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.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Solvent Cements for Joining Plastic Piping:
  1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

## 2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Unions: MSS SP-107, PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

## 2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

## 2.6 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch 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. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.

## 2.7 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, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, and chrome-plated finish.

## 2.8 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Sealing Elements: EPDM 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. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## PART 3 - EXECUTION

### 3.1 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove all portions of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  2. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### 3.2 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.
- F. Install piping 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. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
- M. Sleeves are not required for core-drilled holes.

- N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- O. 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 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 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.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
  - 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.
- P. 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 "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections 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. 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 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.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. 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 Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

### 3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.5 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. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### 3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

END OF SECTION 220500

## SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING 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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

## 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

## PART 2 - PRODUCTS

## 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

## 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

## 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.

- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

#### 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

#### 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.



- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

## 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.
  - 3. Test plugs.
- B. Related Sections:
  - 1. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.

## 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.
- B. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale range, and location for each.
- C. Product Certificates: For each type of thermometer and gage, signed by product manufacturer.

## PART 2 - PRODUCTS

## 2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- 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. Ashcroft.
  - 2. Terrice, H. O. Co.
  - 3. Weiss Instruments, Inc.

- B. Case: Die-cast aluminum or brass, 9 inches long.
- C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. 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 BIMETALLIC-ACTUATED DIAL THERMOMETERS

- 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. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
  - 2. Terice, H. O. Co.
  - 3. Weiss Instruments, Inc.
- B. Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.
- C. Element: Bimetal coil.
- D. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Pointer: Red or other dark-color metal.
- F. Window: Glass.
- G. Ring: Stainless steel.
- H. Connector: Adjustable angle type.
- I. Stem: Metal, for thermowell installation and of length to suit installation.
- J. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.
- K. Case: Dry type, stainless steel with 3-inch diameter.

## 2.3 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

## 2.4 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. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
  2. Trerice, H. O. Co.
  3. Weiss Instruments, Inc.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
1. Case: Dry type, drawn steel or cast aluminum, 3-inch diameter.
  2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
  3. Pressure Connection: Brass, NPS 1/4, 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.
  8. Ring: Metal.
  9. Accuracy: Grade B, plus or minus 2 percent of middle half scale.
  10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
  11. Range for Fluids under Pressure: Two times operating pressure.
- C. Pressure-Gage Fittings:
1. Valves: NPS 1/4 brass or stainless-steel needle type.
  2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

## 2.5 TEST PLUGS

- A. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- B. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- C. Core Inserts: One or two self-sealing rubber valves.
1. Insert material for water service at 20 to 200 deg F shall be CR.

## PART 3 - EXECUTION

### 3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass or bimetallic-actuated dial thermometers in the outlet of each domestic, hot-water storage tank.
- B. Install bimetallic-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.

2. Domestic Cold Water: 0 to 100 deg F, with 2-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.

### 3.3 INSTALLATIONS

- A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees where thermometers are indicated.
- B. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- C. Install needle-valve and snubber fitting in piping for each pressure gage.
- D. Install test plugs in tees in piping.
- E. Install permanent indicators on walls or brackets in accessible and readable positions.
- F. Install connection fittings for attachment to portable indicators in accessible locations.
- G. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.
- H. Adjust faces of thermometers and gages to proper angle for best visibility.

END OF SECTION 220519

## 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. This Section includes the following general-duty valves:
  - 1. Copper-alloy ball valves.
  - 2. Bronze check valves.
  - 3. Bronze gate valves.
- B. Related Sections include the following:
  - 1. Division 21 fire-suppression piping Sections for fire-protection valves.
  - 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and charts.
  - 3. Division 22 piping Sections for specialty valves applicable to those Sections only.

## 1.3 DEFINITIONS

- A. The following are standard abbreviations for valves:
  - 1. CWP: Cold working pressure.
  - 2. PTFE: Polytetrafluoroethylene plastic.
  - 3. TFE: Tetrafluoroethylene plastic.

## 1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

## 1.5 QUALITY ASSURANCE

- A. 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.
  - 2. Protect threads.

3. Set gate valves closed to prevent rattling.
  4. Set ball valves open to minimize exposure of functional surfaces.
  5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
  2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

## 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.

### 2.2 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- D. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- E. Valve Actuators:
1. Handwheel: For valves other than quarter-turn types.
  2. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
- F. Extended Valve Stems: On insulated valves.
- G. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
1. Solder Joint: With sockets according to ASME B16.18.
    - a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
  2. Threaded: With threads according to ASME B1.20.1.
- H. Valve Bypass and Drain Connections: MSS SP-45.

### 2.3 COPPER-ALLOY BALL VALVES

#### A. Available Manufacturers:

1. Two-Piece, Copper-Alloy Ball Valves:
  - a. Conbraco Industries, Inc.; Apollo Div.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Div.
  - e. Hammond Valve.
  - f. Milwaukee Valve Company.
  - g. NIBCO INC.
  - h. Red-White Valve Corp.
  - i. Watts Industries, Inc.; Water Products Div.

#### B. Copper-Alloy Ball Valves, General: MSS SP-110.

#### C. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

### 2.4 BRONZE CHECK VALVES

#### A. Available Manufacturers:

1. Type 4, Bronze, Swing Check Valves with Nonmetallic Disc:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Div.
  - d. Hammond Valve.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Red-White Valve Corp.
  - h. Watts Industries, Inc.; Water Products Div.

#### B. Bronze Check Valves, General: MSS SP-80.

#### C. Type 4, Class 125, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

### 2.5 BRONZE GATE VALVES

#### A. Available Manufacturers:

1. Type 1, Bronze, Nonrising-Stem Gate Valves:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Div.
  - d. Hammond Valve.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Red-White Valve Corp.



- h. Watts Industries, Inc.; Water Products Div.
- B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.
- C. Type 1, Class 125, Bronze Gate Valves: Bronze body with nonrising stem and bronze solid wedge and union-ring bonnet.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. 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.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. 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.
- F. Do not attempt to repair defective valves; replace with new valves.

#### 3.2 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball or gate valves.
  - 2. Pump Discharge: Spring-loaded, lift-disc check valves.
- B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.
- C. Domestic Water Piping: Use the following types of valves:
  - 1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
  - 2. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
  - 3. Gate Valves, NPS 2 and Smaller: Type 1, Class 125, bronze.
- D. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends.

### 3.3 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.

### 3.4 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

### 3.5 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 220523

## SECTION 220529 - HANGERS AND SUPPORTS 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. This Section includes the following hangers and supports for plumbing system piping and equipment:
  - 1. Steel pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
  - 4. Thermal-hanger shield inserts.
  - 5. Fastener systems.
  - 6. Pipe stands.
  - 7. Equipment supports.
- B. Related Sections include the following:
  - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

## 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

## 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.
  - 2. Thermal-hanger shield inserts.
  - 3. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze pipe hangers. Include Product Data for components.
  - 2. Metal framing systems. Include Product Data for components.
  - 3. Pipe stands. Include Product Data for components.
  - 4. Equipment supports.

## 1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."
  - 2. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

## 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.

### 2.2 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. Grinnell Corp.
  - 4. National Pipe Hanger Corporation.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

### 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from 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. Thomas & Betts Corporation.
  - 3. Unistrut Corp.; Tyco International, Ltd.

- C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

## 2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Available Manufacturers:
  - 1. Carpenter & Paterson, Inc.
  - 2. PHS Industries, Inc.
  - 3. Pipe Shields, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.6 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Available Manufacturers:
    - a. B-Line Systems, Inc.; a division of Cooper Industries.
    - b. Hilti, Inc.
    - c. ITW Ramset/Red Head.

## 2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components.

## 2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

## 2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

### 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. 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.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
  - 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
- F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- H. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. C-Clamps (MSS Type 23): For structural shapes.
  2. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
  3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- I. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- J. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- K. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- L. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- M. Use pipe positioning systems in pipe spaces behind plumbing 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. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

- H. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. 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.
- M. 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. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. 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 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - 5. Insert Material: Length at least as long as protective shield.
  - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.



### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

## SECTION 220548 - VIBRATION AND SEISMIC CONTROLS 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. This Section includes the following:
  - 1. Isolation pads.
  - 2. Isolation hangers.

## 1.3 DEFINITIONS

- A. ASCE: American Society of Civil Engineers.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Design Criteria:
  - 1. Plumbing Piping and Equipment components are exempt from the requirements of ASCE 7 Chapter 13 Seismic Design for Nonstructural Components.
  - 2. Refer to Structural General Notes Sheet S001.
  - 3. Building Occupancy Category: III
  - 4. Site Class: D
  - 5. Seismic Design Category: B

## 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

## PART 2 - PRODUCTS

## 2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
  2. Kinetics Noise Control.
  3. Mason Industries.
- B. Isolation Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern, and factory cut to sizes that match requirements of supported equipment.
1. Basis of Design: Mason Industries Super W Pads
  2. Resilient Material: Oil- and water-resistant neoprene.
- C. Spring and Neoprene Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Basis of Design: Mason Industries 30N
  2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 5.
  6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 7.
  8. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  9. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
  10. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

## 2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
  2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
  3. Baked enamel or powder coat for metal components on isolators for interior use.
  4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 APPLICATIONS

- A. Domestic water booster:
  - 1. Isolation Pads.
- B. Domestic water piping at booster pump suction and 25 ft downstream of equipment connection:
  - 1. Spring and Neoprene Hangers with 1" deflection.

## 3.3 VIBRATION-CONTROL DEVICE INSTALLATION

- A. General: Vibration control devices for equipment and distribution systems shall be installed in strict accordance with the requirements of approved Submittals.

## 3.4 FIELD QUALITY CONTROL

- A. Vibration Isolator Testing: Perform the following field quality control testing:
  - 1. Isolator deflection.
  - 2. Isolator minimum clearances.

## 3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.

END OF SECTION 220548

## 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. Pipe labels.
  - 3. Valve tags.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. 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. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
  - 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.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, 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 rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. 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.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

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.

## 2.3 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch 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 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.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and 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 along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

### 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.

END OF SECTION 220553

## 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. Mineral fiber.
  - 2. Adhesives.
  - 3. Factory-applied jackets.
  - 4. Field-applied jackets.
- B. Related Sections include the following:
  - 1. Division 23 Section "HVAC Insulation."

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets both factory and field applied.
- B. Qualification Data: For qualified Installer.
- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program.
- 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.



2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 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.

### PART 2 - PRODUCTS

#### 2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Mineral-Fiber, Preformed Pipe Insulation:
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Johns Manville; Micro-Lok.
    - b. Knauf Insulation; 1000.
    - c. Manson Insulation Inc.; Alley-K.
    - d. Owens Corning; Fiberglas Pipe Insulation.
  2. Type I, 850 deg F 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 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

### 2.3 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.

### 2.4 FIELD-APPLIED JACKETS

- A. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto PVC Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  - 2. Adhesive: As recommended by jacket material manufacturer.
  - 3. Color: White.
  - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricated.

## 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.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; 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- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to 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 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 Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. 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 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- C. 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 "Penetration Firestopping."

### 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.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
- 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.

### 3.6 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 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 Flanges:
1. Install preformed 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 mineral-fiber blanket insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 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.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Underground piping.
  2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.8 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
2. NPS 1-1/4 and Larger: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot Water (portions of system not electric heat traced):

1. NPS 1-1/4 and Smaller: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

C. Domestic Hot Water (portions of system with electric heat trace):

1. NPS 1 and Smaller: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
2. NPS 1-1/4 and 1-1/2: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
3. NPS 2: Insulation shall be the following:

- a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inch thick.
  - D. Stormwater and Overflow:
    - 1. All Pipe Sizes: Insulation shall be the following:
      - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - E. Roof Drain Bodies:
    - 1. All Pipe Sizes: Insulation shall be the following:
      - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - F. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
    - 1. All Pipe Sizes: Refer to Plumbing Fixture Specification Section.
  - G. Condensate and Equipment Drain Water below 60 Deg F:
    - 1. All Pipe Sizes: Insulation shall be the following:
      - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- 3.9 FIELD-APPLIED JACKET SCHEDULE
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
  - B. Piping, Exposed: PVC: 20 mils thick.
    - 1. Kitchen and Food Service areas.

END OF SECTION 220700

## SECTION 221113 - FACILITY 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, including in particular, Section 018113 Sustainable Design Requirements.
- B. Portland Water District specifications and details, latest edition.

## 1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for combined water and fire service mains. All work related to this section shall be reviewed and approved by the Portland Water District (PWD) and shall meet the Portland Water District specifications and details, latest edition.
- B. Project utility drawings have been reviewed by the Portland Water District.

## 1.3 DEFINITIONS See PWD specifications and details.

## 1.4 SUBMITTALS See PWD specifications and details.

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: as required by PWD.
- C. Field quality-control test reports. As required by PWD.
- D. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

## 1.5 QUALITY ASSURANCE See PWD specifications and details.

- A. Regulatory Requirements:
  - 1. Comply with requirements of Portland Water District. 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.



1.6 DELIVERY, STORAGE, AND HANDLING See PWD specifications and details.

1.7 PROJECT CONDITIONS See PWD specifications and details.

1.8 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS See PWD specifications and details.

2.1 DUCTILE-IRON PIPE AND FITTINGS See PWD specifications and details.

2.2 SPECIAL PIPE FITTINGS See PWD specifications and details.

2.3 JOINING MATERIALS See PWD specifications and details.

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for commonly used joining materials.

2.4 PIPING SPECIALTIES See PWD specifications and details.

2.5 GATE VALVES See PWD specifications and details.

2.6 GATE VALVE ACCESSORIES AND SPECIALTIES See PWD specifications and details.

2.7 BUTTERFLY VALVES See PWD specifications and details.

2.8 WATER METERS - See PWD specifications and details.

- A. Current water meter shall be returned for credit to PWD
- B. Larger new water will be furnished and installed by PWD and paid under this contract.

- 2.9 PRESSURE-REDUCING VALVES See PWD specifications and details.
- 2.10 BACKFLOW PREVENTERS See PWD specifications and details.
- 2.11 WATER METER BOXES See PWD specifications and details.
- 2.12 CONCRETE VAULTS See PWD specifications and details.
- 2.13 PROTECTIVE ENCLOSURES See PWD specifications and details.
- 2.14 FIRE HYDRANTS See PWD specifications and details.
  - a. .
- 2.15 FLUSHING HYDRANTS See PWD specifications and details.
- 2.16 FIRE DEPARTMENT CONNECTIONS See PWD specifications and details.
- 2.17 ALARM DEVICES See PWD specifications and details

### PART 3 - EXECUTION

- 3.1 EARTHWORK
  - A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.
- 3.2 PIPING APPLICATIONS See PWD specifications and details
- 3.3 VALVE APPLICATIONS See PWD specifications and details
- 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 See PWD specifications and details
  - A. See Division 21 Section "Water-Based Fire-Suppression Systems" for fire-suppression-water piping inside the building.
  - B. See Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.

- 3.6 JOINT CONSTRUCTION See PWD specifications and details
- A. See Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- 3.7 ANCHORAGE INSTALLATION See PWD specifications and details
- 3.8 VALVE INSTALLATION See PWD specifications and details
- 3.9 WATER METER INSTALLATION See PWD specifications and details
- 3.10 VACUUM BREAKER ASSEMBLY INSTALLATION See PWD specifications and details
- A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.
- 3.11 BACKFLOW PREVENTER INSTALLATION See PWD specifications and details
- 3.12 WATER METER BOX INSTALLATION See PWD specifications and details
- 3.13 CONCRETE VAULT INSTALLATION See PWD specifications and details
- A. Install precast concrete vaults according to ASTM C 891.
- 3.14 FIRE HYDRANT INSTALLATION See PWD specifications and details
- 3.15 FIRE DEPARTMENT CONNECTION INSTALLATION
- A. Install ball drip valves at each check valve for fire department connection to mains.
- B. Install protective pipe bollards on two sides of the hydrant, location to be approved by the Portland Fire Department.
- 3.16 CONNECTIONS See PWD specifications and details
- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. See Division 22 Section "Common Work Results for Plumbing" for piping connections to valves and equipment.
- C. Connect water-distribution piping to existing water main. Use method approved and inspected by Portland Water District.

- D. Connect water-distribution piping to interior domestic water and fire-suppression piping.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.17 FIELD QUALITY CONTROL See PWD specifications and details.

- A. Prepare reports of testing activities. Project Engineer to receive copies of all testing reports.

3.18 IDENTIFICATION See PWD specifications and details

3.19 CLEANING See PWD specifications and details

- A. Prepare reports of purging and disinfecting activities. Project engineer to receive copies of reports.

END OF SECTION 221113

## 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. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
- 2. Specialty valves.
- 3. Flexible connectors.
- 4. Water meters furnished by utility company for installation by Contractor.

## B. Related Section:

- 1. Division 22 Section "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

## 1.3 SUBMITTALS

## A. Product Data: For the following products:

- 1. Specialty valves.
- 2. Transition fittings.
- 3. Dielectric fittings.
- 4. Flexible connectors.

## B. Water Samples: Specified in "Cleaning" Article.

## C. Field quality-control reports.

## 1.4 QUALITY ASSURANCE

## A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

## B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

## C. Comply with NSF 61 for potable domestic water piping and components.

## 1.5 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.
  - 2. Do not proceed with interruption of water service without Owner's written permission.

## 1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## 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 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.
  - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
  - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
  - 5. Copper Pressure-Seal-Joint Fittings:
    - a. Manufacturer: (Only)
      - 1) Viega; Plumbing and Heating Systems.
    - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
    - c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
  - 6. Grooved-Joint Copper-Tube Appurtenances:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Anvil International.
      - 2) Shurjoint Piping Products.
      - 3) Victaulic Company.
    - b. Copper Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
    - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

### 2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
  - 1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.

### 2.4 PEX TUBE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Rehau.
  - 2. Viega.
  - 3. Uponor.
  - 4. Watts.
  - 5. Zurn.
- B. PEX tube: ASTM F876 and F877, potable water tube certified to NSF standards 14 and 61. Rated 200°F at 80 psi, 180°F at 100 psi, and 73.4°F at 160 psi.
- C. Fittings for PEX Tube: ASTM F1807 brass insert, compression sleeve type, or crimp fittings with joining method matching tube manufacturers requirements.
- D. PEX tubing shall only be installed for underslab distribution applications. Refer to Part 3.

### 2.5 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

### 2.6 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

### 2.7 TRANSITION FITTINGS

- A. 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.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

## 2.8 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Description:

- a. Pressure Rating: 150 psig at 180 deg F.
- b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Description:

- a. Factory-fabricated, bolted, companion-flange assembly.
- b. Pressure Rating: 150 psig.
- c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

1. Description:

- a. Nonconducting materials for field assembly of companion flanges.
- b. Pressure Rating: 150 psig.
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Description:

- a. Galvanized-steel coupling.
- b. Pressure Rating: 300 psig at 225 deg F.
- c. End Connections: Female threaded.
- d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

1. Description:

- a. Electroplated steel nipple complying with ASTM F 1545.
- b. Pressure Rating: 300 psig at 225 deg F.
- c. End Connections: Male threaded or grooved.
- d. Lining: Inert and noncorrosive, propylene.



## 2.9 FLEXIBLE CONNECTORS

- 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. Flex-Hose Co., Inc.
  2. Mercer Rubber Co.
  3. Metraflex, Inc.
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig.
  2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
  3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

## 2.10 WATER METERS

- A. Furnished by Water District.

## PART 3 - EXECUTION

## 3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

## 3.2 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 copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- H. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. 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.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping adjacent to equipment and specialties to allow service and maintenance.
- N. Install piping to permit valve servicing.
- O. 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.
- P. Install piping free of sags and bends.
- Q. Install fittings for changes in direction and branch connections.
- R. Install PEX piping with loop at each change of direction of more than 90 degrees.
- S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- T. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- U. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- V. Install sleeves and escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements specified in Division 22 Section "Common Work Results for Plumbing."

### 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. 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.
- D. 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."
- E. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

- F. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
- G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- H. PEX Piping Joints: Join according to ASTM F 1807.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 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 or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- 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.

### 3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.

### 3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings, nipples, or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.

### 3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.

### 3.8 WATER METER INSTALLATION

- A. Rough-in domestic water piping for water meter installation, and install water meters according to utility company's requirements.
- B. Water meters will be furnished and installed by utility company.
- C. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

### 3.9 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs: MSS Type 1, adjustable, steel clevis hangers.
  - 3. Multiple, Straight, Horizontal Piping Runs: Support pipes on trapeze.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for vertical PEX piping every 48 inches.
- H. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### 3.10 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 exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: 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.
4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.11 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.

### 3.12 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:
    - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or 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 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.

### 3.13 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. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.14 CLEANING

- A. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
  - a. Flush piping system with clean, potable water until dirty water does not appear at 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 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 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. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
  - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

- C. Prepare and submit reports of purging and disinfecting activities.

- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.15 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water, building-service piping, NPS 4, shall be the following:
  - 1. Mechanical-joint, ductile-iron pipe; standard- pattern mechanical-joint fittings; and mechanical joints.
- D. Under-building-slab, domestic water supply between trap primer assembly and tubing serving floor drains, shall be the following:
  - 1. PEX Tube, NPS 3/4 and smaller. Fittings shall not be installed under-building slab except at final connection to floor drain. PEX tube must be sleeved with schedule 40 PVC elbow and stub-up at slab penetration.
- E. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
  - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
  - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
  - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
  - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
  - 3. Hard copper tube, ASTM B 88, Type L; grooved-joint copper-tube appurtenances; and grooved joints.

### 3.16 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 or gate valves for piping NPS 2 and smaller. Use ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
  - 2. Throttling Duty: Use globe valves for piping NPS 2 and smaller. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

## 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. Backflow preventers.
3. Water pressure-reducing valves.
4. Temperature-actuated water mixing valves.
5. Strainers.
6. Outlet boxes.
7. Hose bibbs.
8. Hose stations.
9. Wall hydrants.
10. Drain valves.
11. Water hammer arresters.
12. Air vents.
13. Trap-seal primer systems.

- B. Related Sections include the following:

1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, 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. 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."

## PART 2 - PRODUCTS

## 2.1 VACUUM BREAKERS

## A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Conbraco Industries, Inc.
  - 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, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

## 2.2 BACKFLOW PREVENTERS

## A. Reduced-Pressure-Principle Backflow Preventers:

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.
  - a. Conbraco Industries, Inc.
  - b. FEBCO; SPX Valves & Controls.
  - c. Watts Industries, Inc.; Water Products Div.
  - d. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1013.
4. Operation: Continuous-pressure applications.
5. Pressure Loss: 10 psig maximum, through middle 1/3 of flow range.
6. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved.
7. End Connections: Threaded for NPS 2 and smaller.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:
  - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

### 2.3 WATER PRESSURE-REDUCING VALVES

#### A. Water Regulators:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Conbraco Industries, Inc.
  - b. Watts Industries, Inc.; Water Products Div.
  - c. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze for NPS 2 and smaller
5. End Connections: Threaded for NPS 2 and smaller.

### 2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

#### A. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
  - a. Lawler Manufacturing Company, Inc.
  - b. Leonard Valve Company.
  - c. Powers; a Watts Industries Co.
  - d. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Exposed-mounting, thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded or union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
9. Tempered-Water Setting: 120 deg F.
10. Selected Valve Flow Rate at 10-psig Pressure Drop:
11. Valve Finish: Rough bronze.
12. Piping Finish: Copper.

### 2.5 STRAINERS FOR DOMESTIC WATER PIPING

#### A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller
3. End Connections: Threaded for NPS 2 and smaller.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
  - a. Strainers NPS 2 and Smaller: 0.033 inch.

6. Drain: Pipe plug.

## 2.6 OUTLET BOXES

### A. Clothes Washer Outlet Boxes (Tagged WB-1):

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Guy Gray Manufacturing Co., Inc.
  - b. IPS Corporation.
  - c. Oatey.
  - d. Symmons Industries, Inc.
  - e. Watts Industries, Inc.; Water Products Div.
  - f. Zurn Plumbing Products Group; Light Commercial Operation.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel or plastic box and faceplate.
4. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.

## 2.7 HOSE BIBBS

### A. General Interior Service Area Applications (Tagged HB-1):

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. 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.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Service Areas: Chrome or nickel plated.

## 2.8 WALL HYDRANTS

### A. Non-freeze Wall Hydrants (Tagged WH-1):

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. 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 (Basis of Design: Z1231).
2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Nozzle and Wall-Plate Finish: Polished Nickel Bronze.
9. Operating Keys(s): Two with each wall hydrant.

## 2.9 DRAIN VALVES

### A. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.10 WATER HAMMER ARRESTERS

### A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
  - a. PPP Inc.
  - b. Sioux Chief Manufacturing Company, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Watts Drainage Products Inc.
  - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

## 2.11 AIR VENTS

### A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

## 2.12 TRAP-SEAL PRIMER SYSTEMS

### A. Trap-Seal Primer Systems

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
  - a. PPP Inc., Model #PR-500
  - b. Sioux Chief Manufacturing Company, Inc.
  - c. Zurn.
2. Supply type trap primer valve with bronze body, 125 psig minimum working pressure.
3. Standard: ASSE 1018
4. Piping: NPS 1/2, ASTM B 88, Type L; copper, water tubing.
5. Vacuum Breaker: ASSE 1001.
6. Number Outlets: As indicated on Drawings.
7. Size Outlets: NPS 1/2.

## 2.13 ELECTRONIC TRAP-PRIMER SYSTEM

### A. Electronic Trap-Primer Controls (Tagged TP-\*)

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
  - a. PPP Inc.
  - b. Zurn.
2. Operation: provide a 6 second water injection to traps every 24 hours.
3. Cabinet: Galvanized steel for either surface or recessed mounting w/ cover.
4. Inlet Connections: NPS 1/2 solder joint.
5. Outlet Connections: 1/2 Male PEX connections. Provide quantity as scheduled with 5 outlets minimum.
6. Provide with the following:
  - a. Electronic Module with fuse protection.
  - b. Brass ball valve.
  - c. Slow closing 24 VAC solenoid valve with integral strainer.
  - d. 120-24VAC transformer
  - e. Brass atmospheric vacuum breaker.
  - f. PEX waterway
  - g. Anti-scaling multi-port manifold

## 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 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. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
- F. Install Y-pattern strainers for water on supply side of each, water pressure-reducing valve,.
- G. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- H. Install water hammer arresters in water piping according to PDI-WH 201.
- I. Install air vents at high points of water piping.
- J. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

### 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 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
  - 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.4 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.

END OF SECTION 221119

## SECTION 221133 - 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. Pressure regulators.

## 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: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.

## 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. Pressure regulators. Indicate pressure ratings and capacities.



- B. Welding certificates.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. 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.

#### 1.7 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.
- D. Protect stored PE pipes and valves from direct sunlight.

#### 1.8 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.

#### 1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

### 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.
    - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
- B. PE Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
  2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
    - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
    - c. Aboveground Portion: PE transition fitting.
    - d. Outlet shall be threaded or flanged or suitable for welded connection.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
  4. Transition Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    - b. Outlet shall be threaded or flanged or suitable for welded connection.
    - c. Bridging sleeve over mechanical coupling.
    - d. Factory-connected anode.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
  5. Plastic Mechanical Couplings, NPS 1-1/2 and Smaller: Capable of joining PE pipe to PE pipe.
    - a. PE body with molded-in, stainless-steel support ring.
    - b. Buna-nitrile seals.
    - c. Acetal collets.
    - d. Electro-zinc-plated steel stiffener.
  6. Plastic Mechanical Couplings, NPS 2 and Larger: Capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
    - a. Fiber-reinforced plastic body.

- b. PE body tube.
  - c. Buna-nitrile seals.
  - d. Acetal collets.
  - e. Stainless-steel bolts, nuts, and washers.
7. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
- a. Stainless-steel flanges and tube with epoxy finish.
  - b. Buna-nitrile seals.
  - c. Stainless-steel bolts, washers, and nuts.
  - d. Factory-installed anode for steel-body couplings installed 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.
  - 6. End Fittings: Zinc-coated steel.
  - 7. Threaded Ends: Comply with ASME B1.20.1.
- B. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

## 2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 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 and Smaller: Comply with ASME B16.33.
- 1. CWP Rating: 125 psig.
  - 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 and smaller.
  - 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

- C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
1. CWP Rating: 125 psig.
  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. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
  2. Ball: Chrome-plated brass.
  3. Stem: Bronze; blowout proof.
  4. Seats: Reinforced TFE; blowout proof.
  5. Packing: Separate packnut with adjustable-stem packing threaded ends.
  6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  7. CWP Rating: 600 psig.
  8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
  2. Ball: Chrome-plated bronze.
  3. Stem: Bronze; blowout proof.
  4. Seats: Reinforced TFE; blowout proof.
  5. Packing: Threaded-body packnut design with adjustable-stem packing.
  6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  7. CWP Rating: 600 psig.
  8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
  2. Ball: Chrome-plated bronze.
  3. Stem: Bronze; blowout proof.
  4. Seats: Reinforced TFE.
  5. Packing: Threaded-body packnut design with adjustable-stem packing.
  6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  7. CWP Rating: 600 psig.
  8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- G. Bronze Plug Valves: MSS SP-78.
1. Body: Bronze, complying with ASTM B 584.
  2. Plug: Bronze.

3. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Operator: Square head or lug type with tamperproof feature where indicated.
5. Pressure Class: 125 psig.
6. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Body: Cast iron, complying with ASTM A 126, Class B.
2. Plug: Bronze or nickel-plated cast iron.
3. Seat: Coated with thermoplastic.
4. Stem Seal: Compatible with natural gas.
5. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
6. Operator: Square head or lug type with tamperproof feature where indicated.
7. Pressure Class: 125 psig.
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

I. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Body: Cast iron, complying with ASTM A 126, Class B.
2. Plug: Bronze or nickel-plated cast iron.
3. Seat: Coated with thermoplastic.
4. Stem Seal: Compatible with natural gas.
5. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
6. Operator: Square head or lug type with tamperproof feature where indicated.
7. Pressure Class: 125 psig.
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

## 2.5 MOTORIZED GAS VALVES

A. Automatic Gas Valves: Comply with ANSI Z21.21.

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. ASCO Power Technologies, LP; Division of Emerson.
  - b. Dungs, Karl, Inc.
  - c. Eaton Corporation; Controls Div.
  - d. Eclipse Combustion, Inc.
  - e. Honeywell International Inc.
  - f. Johnson Controls.
2. Body: Brass or aluminum.
3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. Normally closed.

6. Visual position indicator.
7. Mechanical operator for actuation by appliance automatic shutoff device.

B. Electrically Operated Valves: Comply with UL 429.

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. ASCO Power Technologies, LP; Division of Emerson.
  - b. Dungs, Karl, Inc.
  - c. Eclipse Combustion, Inc.
  - d. Goyen Valve Corp.; Tyco Environmental Systems.
  - e. Magnatrol Valve Corporation.
  - f. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
  - g. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
2. Pilot operated.
3. Body: Brass or aluminum.
4. Seats and Disc: Nitrile rubber.
5. Springs and Valve Trim: Stainless steel.
6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
7. NEMA ICS 6, Type 4, coil enclosure.
8. Normally closed.
9. Visual position indicator.

## 2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Furnished and installed by Utility, Bangor Gas.

C. Line Pressure Regulators: Comply with ANSI Z21.80.

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. Actaris.
  - b. American Meter Company.
  - c. Eclipse Combustion, Inc.
  - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
  - e. Invensys.
  - f. Maxitrol Company.
  - g. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.

6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2 psig.

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.

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. Eaton Corporation; Controls Div.
  - b. Harper Wyman Co.
  - c. Maxitrol Company.
  - d. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig.

## 2.7 SERVICE METERS

- A. Furnished and installed by Utility, Bangor Gas.

## 2.8 DIELECTRIC FITTINGS

A. Dielectric Unions:

1. Minimum Operating-Pressure Rating: 150 psig.
2. Combination fitting of copper alloy and ferrous materials.
3. Insulating materials suitable for natural gas.
4. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

1. Minimum Operating-Pressure Rating: 150 psig.
2. Combination fitting of copper alloy and ferrous materials.
3. Insulating materials suitable for natural gas.
4. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

## C. Dielectric-Flange Kits:

1. Minimum Operating-Pressure Rating: 150 psig.
2. Companion-flange assembly for field assembly.
3. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

## 2.9 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

## 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 to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

## 3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Utility, Bangor Gas, shall provide underground natural gas service line to building.
- C. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.
- D. Install underground, PE, natural-gas piping according to ASTM D 2774.
- E. Install fittings for changes in direction and branch connections.

## 3.4 INDOOR PIPING INSTALLATION



- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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 by Engineer.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- 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 long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. 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.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
  - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
  - 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing

rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.

3. 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.
4. 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.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install pressure gage downstream from each line regulator.
- W. Install sleeves for piping penetrations of walls, ceilings, and floors.
- X. Install sleeve seals for piping penetrations of concrete walls and slabs.
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### 3.5 SERVICE-METER ASSEMBLY INSTALLATION

- A. Furnished and installed by Utility, Bangor Gas.

### 3.6 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

### 3.7 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.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. 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.

## D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

## 3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

## 3.9 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 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.

### 3.10 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### 3.11 PAINTING

- A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and piping specialties, except components, with factory-applied paint or protective coating.
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

### 3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Test, inspect, and purge natural gas according to NFPA 54 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.

### 3.13 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be the following:
  - 1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
- B. Aboveground natural-gas piping shall be one of the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with wrought-steel fittings and welded joints.

### 3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with steel welding fittings and welded joints.

3.16 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves at service meter shall be furnished and installed by Utility, Bangor Gas.

B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, **[full] [regular]**-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

C. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

1. Two-piece, **[full] [regular]**-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, **[nonlubricated] [lubricated]** plug valve.

D. Valves in branch piping for single appliance shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, **[full] [regular]**-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

END OF SECTION 221133

## SECTION 221313 - FACILITY 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, including in particular, Section 018113 Sustainable Design Requirements.
- B. Sanitary sewer shall meet all requirements of the City of Portland "Technical and Design Standards", including requirements for inspection by the Department of Public Services City Engineer during construction.
- C. Sanitary sewer shall also meet specifications of the Portland Water District (PWD) for pipe and installation criteria

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Pipe and fittings.
  - 2. Nonpressure couplings.
  - 3. Expansion joints and deflection fittings.
  - 4. Backwater valves.
  - 5. Cleanouts.
  - 6. Manholes.

## 1.3 DEFINITIONS

- A. PVC – polyvinyl chloride

## 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Pipe and fittings
  - 2. Expansion joints and deflection fittings.
  - 3. Backwater valves.
- B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.
- C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- D. Profile Drawings: Show system piping in elevation. Draw profiles to horizontal scale of not less than 1 inch equals 50 feet and to vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

- E. Field quality-control reports.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

#### 1.6 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities owned by the City of Portland unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify City of Portland Public Services Department no fewer than 2 business days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of service without City of Portland, Department of Public Services', written permission.

### PART 2 - PRODUCTS

- 2.1 PVC PIPE AND FITTINGS – to meet City of Portland specifications for nonpressure sanitary sewer pipe and fittings.
- 2.2 NONPRESSURE-TYPE TRANSITION COUPLINGS to meet City of Portland specifications for nonpressure sanitary sewer pipe and fittings.
- 2.3 BACKWATER VALVES to meet City of Portland specifications for nonpressure sanitary sewer pipe and fittings.
- 2.4 CLEANOUTS to meet City of Portland specifications for nonpressure sanitary sewer pipe and fittings.
- 2.5 MANHOLES
  - A. Standard Precast Concrete Manholes:
    - 1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
    - 2. Diameter: 48 inches minimum unless otherwise indicated.
    - 3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
    - 4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
    - 5. Riser Sections: 5-inch minimum thickness, of length to provide depth indicated.

6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: Individual FRP steps or FRP ladder]; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals.
10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

2.6 Manhole Frames and Covers: to meet City of Portland specifications

### PART 3 - EXECUTION

#### 3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

#### 3.2 PIPING INSTALLATION

- A. Installation shall be inspected by the City of Portland Engineer. No connection to the City of Portland sewer line without the approval of the City Engineer.
- B. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- C. 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.
- D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- E. Install gravity-flow, nonpressure, drainage piping according to the following: City of Portland and manufacturer's specifications.
- F. 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: City of Portland and manufacturer's specifications.
- B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

### 3.4 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Form continuous concrete channels and benches between inlets and outlet or install preformed channel approved by the City of Portland engineer.
- D. Set tops of frames and covers as specified by City of Portland Engineer

### 3.5 BACKWATER VALVE INSTALLATION

- A. Install horizontal-type backwater valves in piping manholes or pits.
- B. Install combination horizontal and manual gate valves in piping and in manholes.
- C. Install terminal-type backwater valves on end of piping and in manholes. Secure units to sidewalls.

### 3.6 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. All connections shall be inspected and approved by City of Portland Engineer.
  - 1. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
    - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
  - 2. 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.

3.7 IDENTIFICATION as required by City of Portland Engineer

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
  - 1. Use detectable warning tape over ferrous piping.
  - 2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.8 FIELD QUALITY CONTROL

- A. Field Quality Control shall meet the City of Portland Technical Standards or the following, whichever is more stringent.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches 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. Damage: 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.
- C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  - 1. Do not enclose, cover, or put into service before inspection and approval.
  - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
  - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
  - 4. Submit separate report for each test.
  - 5. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
    - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
  - 6. Manholes: Perform hydraulic test according to ASTM C 969.
- D. Leaks and loss in test pressure constitute defects that must be repaired.
- E. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.9 CLEANING

- A. Clean dirt and superfluous material from interior of piping.

END OF SECTION 221313

## 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. Section Includes:

- 1. Pipe, tube, and fittings.
- 2. Specialty pipe fittings.

- B. Related Sections:

- 1. Division 22 Section "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.
- 2. Division 22 Section "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

- 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- 2. Waste, Force-Main Piping: 50 psig.

## 1.4 SUBMITTALS

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

- B. LEED Submittal:

- 1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

- C. Field quality-control reports.

## 1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

## 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 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A74, Service class.
  - 1. Pipe and fittings must be manufactured domestically.
  - 2. Imported pipe and fittings is not acceptable.
- B. Gaskets: ASTM C 564, rubber.

### 2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
  - 1. Pipe and fittings must be manufactured domestically.
  - 2. Imported pipe and fittings is not acceptable.
- B. CISPI, Hubless-Piping Couplings:
  - 1. Standards: ASTM C 1277 and CISPI 310.
  - 2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
  - 1. Standards: ASTM C 1277 and ASTM C 1540.
  - 2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

### 2.4 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.
- D. Copper Pressure Fittings:
  - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- E. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
  2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- F. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

## 2.5 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
1. 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).
- D. Solvent Cement: ASTM D 2564.
1. 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).

## 2.6 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
  2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  3. Shielded, Nonpressure Transition Couplings:
    - a. Standard: ASTM C 1460.
    - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
  4. Pressure Transition Couplings:
    - a. Standard: AWWA C219.
    - b. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
    - c. Center-Sleeve Material: Ductile iron.
    - d. Gasket Material: Natural or synthetic rubber.
    - e. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
  - a. Description:
    - 1) Standard: ASSE 1079.
    - 2) Pressure Rating: 125 psig minimum at 180 deg F 250 psig.
    - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
  - a. Description:
    - 1) Standard: ASSE 1079.
    - 2) Factory-fabricated, bolted, companion-flange assembly.
    - 3) Pressure Rating: 125 psig minimum at 180 deg F.
    - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:
  - a. Description:
    - 1) Nonconducting materials for field assembly of companion flanges.
    - 2) Pressure Rating: 150 psig.
    - 3) Gasket: Neoprene or phenolic.
    - 4) Bolt Sleeves: Phenolic or polyethylene.
    - 5) Washers: Phenolic with steel backing washers.
5. Dielectric Nipples:
  - a. Description:
    - 1) Electroplated steel nipple complying with ASTM F 1545.
    - 2) Pressure Rating: 300 psig at 225 deg F.
    - 3) End Connections: Male threaded or grooved.
    - 4) Lining: Inert and noncorrosive, propylene.

### PART 3 - EXECUTION

#### 3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "Earth Moving."

#### 3.2 PIPING INSTALLATION

- A. Install drain, waste, and vent piping systems in strict accordance with State and Local codes and AHJ.
- B. Coordinate all drain exits at building foundation wall and penetrations.

- C. 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.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- H. Install piping at indicated slopes.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install piping to allow application of insulation.
- L. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- M. 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 two 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.
- N. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- O. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Sanitary Drain and Waste: 1/4 inch/foot downward in direction of flow for piping NPS 4 and smaller; 1/8 inch/foot downward in direction of flow for piping NPS 5 and larger.
  - 2. Vent Piping: slope down toward vertical fixture vent or toward vent stack.
- P. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- Q. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- R. Install underground PVC piping according to ASTM D 2321.
- S. Plumbing Specialties:



1. Install backwater valves in sanitary waste gravity-flow piping. Comply with requirements for backwater valves specified in Division 22 Section "Sanitary Waste Piping Specialties."
  2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Sanitary Waste Piping Specialties."
  3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
- T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- U. Install sleeves escutcheons and for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Common Work Results for Plumbing."

### 3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- E. Plastic, Nonpressure-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 Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

### 3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  1. Install transition couplings at joints of piping with small differences in OD's.
  2. In Drainage Piping: Shielded, nonpressure transition couplings.
  3. In Aboveground Force Main Piping: Fitting-type transition couplings.
- B. Dielectric Fittings:
  1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
  2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
  3. Dielectric Fittings for NPS 2-1/2 and larger: Use dielectric flange kits.

### 3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves:
  - 1. Install shutoff valve on each sump pump discharge.
  - 2. Install gate or full-port ball valve for piping NPS 2 and smaller.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
  - 1. Horizontal Piping: Horizontal backwater valves.
  - 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
  - 3. Install backwater valves in accessible locations.
  - 4. Comply with requirements for backwater valve specified in Division 22 Section "Sanitary Waste Piping Specialties."

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  - 2. NPS 3: 60 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
- I. Install supports for vertical copper tubing every 10 feet.

- J. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
  - 2. NPS 3: 48 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  - 4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
  - 5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.
- K. Install supports for vertical PVC piping every 48 inches.
- L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  - 5. Install horizontal backwater valves in pit with pit cover flush with floor.
  - 6. Comply with requirements for backwater valves cleanouts and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
  - 7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

### 3.9 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. 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. 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.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 2. Cap and subject piping to static-water pressure of 50 psig 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.
  - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 4. Prepare reports for tests and required corrective action.

### 3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris 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.

### 3.11 PIPING SCHEDULE

- A. Aboveground, Soil, Waste, and Vent piping shall be the following:
  - 1. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
- B. Aboveground, Indirect Waste piping (Food Service Areas) shall be the following:
  - 1. Copper DWV tube, copper drainage fittings, and soldered joints.
- C. Aboveground force mains (sump pump discharge) shall be the following:
  - 1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
- D. Underground, Soil, Waste, and Vent piping shall be either of the following:
  - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
  - 2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Underground, Kitchen/Grease Waste and Vent piping (Food Service Area) shall be the following:
  - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.

END OF SECTION 221316

## 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.
  - 3. Floor sinks.
  - 4. Miscellaneous sanitary drainage piping specialties.
  - 5. Solids interceptors.
- B. Related Sections include the following:
  - 1. Division 22 Section "Storm Drainage Piping Specialties" for roof drains.

## 1.3 DEFINITIONS

- A. HDPE: High-density polyethylene plastic.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories
- B. Shop Drawings: Detailed layouts of each channel drain system. Include modular sections, inverts, catch basins, inlets and outlets, and grates.
- C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

## 1.6 COORDINATION

- A. Coordinate size and location of roof penetrations.

## PART 2 - PRODUCTS

## 2.1 CLEANOUTS

## A. Exposed Metal Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Josam Company; Josam Div.
  - 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. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

## B. Metal Floor Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Josam Company; Josam Div.
  - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - c. Tyler Pipe; Wade Div.
  - d. Watts Drainage Products Inc.
  - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Basis of Design: Zurn Z1400.
3. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
4. Size: Same as connected branch.
5. Type: Adjustable housing.
6. Body or Ferrule: Cast iron.
7. Clamping Device: Required.
8. Outlet Connection: Inside calk.
9. Closure: Brass plug with tapered threads.
10. Adjustable Housing Material: Cast iron.
11. Frame and Cover Material and Finish: Rough bronze.
12. Frame and Cover Shape: Round.
13. Top Loading Classification: Medium Duty.
14. Riser: ASTM A 74, service class, cast-iron drainage pipe fitting and riser to cleanout.

## C. Cast-Iron Wall Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Josam Company; Josam Div.
  - 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. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Basis of Design: Zurn Z1441.
3. Standard: ASME A112.36.2M. Include wall access.
4. Size: Same as connected drainage piping.
5. Body: as required to match connected piping.
6. Closure: Countersunk or raised-head, brass plug.
7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
8. Wall Access: Round, cover plate with screw.
9. Wall Access: Nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

## 2.2 FLOOR DRAINS

### A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
  - a. Josam Company; Josam Div.
  - 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. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Basis of Design:
  - a. FD-1: Zurn ZN415B
  - b. FD-2: Zurn Z511, 9" heavy duty drain.
  - c. FD-3: Zurn Z415B with 4" diameter funnel.
3. Standard: ASME A112.6.3.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Top of Body and Strainer Finish:
  - a. FD-1: Nickel bronze.
  - b. FD-2: Ductile iron.
  - c. FD-3: Nickel bronze.
10. Top Shape: Round.
11. Funnel: Provide in locations as indicated on the Drawings.
12. Inlet Fitting: Gray iron, with threaded inlet trap-seal primer valve connection.



## 2.3 FLOOR SINK RECEPTOR

## A. Cast-Iron Receptor:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
  - a. Josam Company; Josam Div.
  - 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. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Basis of Design:
  - a. FS-1: Zurn Z1901 12"x12"x8" deep, white acid resistant porcelain enamel and top, with Z1903 stabilizer.
3. Standard: ASME A112.6.3.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Top of Body and Strainer Finish:
  - a. FS-1: ½ grate.
10. Top Shape: square.
11. Grate: Provide in type as required in locations as indicated on the Drawings.
12. Inlet Fitting: Gray iron, with threaded inlet trap-seal primer valve connection.

## 2.4 MODULAR TRENCH DRAIN (TD-1)

## A. Cast-Iron Receptor:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
  - a. Josam Company; Josam Div.
  - 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. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Basis of Design:
  - a. TD-1: Zurn Z665-C-DB-G 36" long x 12" wide, galvanized cast iron, with heavy duty loose slotted grate and bottom dome strainer.

## 2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

## A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
  - a. NPS 2: 4-inch- minimum water seal.
  - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. 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.

## 2.6 SOLIDS INTERCEPTORS

A. Solids Interceptors:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Rockford Sanitary Systems, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Type: Factory-fabricated interceptor made for removing and retaining plaster from wastewater. Sizes and Basis of Design as indicated on the Drawings and Details.

## 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 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. Use NPS 4 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 50 feet for piping NPS 4 and smaller and 100 feet for larger 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.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  - 1. Position floor drains for easy access and maintenance.
  - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
  - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- G. Assemble open drain fittings and install with top of hub 2 inches above floor.
- H. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
  - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  - 2. Size: Same as floor drain inlet.
- J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- K. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
  - 1. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
  - 2. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.

- 3. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- L. Install wood-blocking reinforcement for wall-mounting-type specialties.
- M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- N. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

### 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 equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

### 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.

END OF SECTION 221319

## SECTION 221413 - STORM DRAINAGE 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. Pipe, tube, and fittings.
- 2. Specialty pipe fittings.

- B. Related Sections:

- 1. Division 22 Section "Sump Pumps" for storm drainage pumps.
- 2. Division 33 Section "Storm Utility Drainage Piping" for storm drainage piping outside the building.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

- 1. Storm Drainage Piping: 10-foot head of water.

## 1.4 SUBMITTALS

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

- B. LEED Submittal:

- 1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

- C. Field quality-control reports.

## 1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

## 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 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service classes.
  - 1. Pipe and fittings must be manufactured domestically.
  - 2. Imported pipe and fittings is not acceptable.
- B. Gaskets: ASTM C 564, rubber.

## 2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
  - 1. Pipe and fittings must be manufactured domestically.
  - 2. Imported pipe and fittings is not acceptable.
- B. CISPI, Hubless-Piping Couplings:
  - 1. Standards: ASTM C 1277 and CISPI 310.
  - 2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
  - 1. Standards: ASTM C 1277 and ASTM C 1540.
  - 2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

## 2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
  - 1. 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).
- D. Solvent Cement: ASTM D 2564.
  - 1. 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).

## 2.5 SPECIALTY PIPE FITTINGS

### A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Shielded, Nonpressure Transition Couplings:
  - a. Standard: ASTM C 1460.
  - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

## PART 3 - EXECUTION

### 3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "Earth Moving."

### 3.2 PIPING INSTALLATION

- A. Install drain piping systems in strict accordance with State and Local codes and AHJ.
- B. Coordinate all drain exits at building foundation wall and penetrations.
- C. 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 from layout are approved on coordination drawings.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- H. Install piping at indicated slopes.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install piping to allow application of insulation.

- L. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- M. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. 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.
- N. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- O. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
  - 1. Storm Drain: 1/4 inch/foot downward in direction of flow for piping NPS 4 and smaller; 1/8 inch/foot downward in direction of flow for piping NPS 5 and larger.
  - 2. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 3. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- P. Install underground PVC piping according to ASTM D 2321.
- Q. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Storm Drainage Piping Specialties."
  - 2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Storm Drainage Piping Specialties."
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves and escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Common Work Results for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- D. Plastic, Nonpressure-Piping, Solvent-Cemented 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 Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

### 3.4 SPECIALTY PIPE FITTING INSTALLATION

#### A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  2. NPS 3: 60 inches with 1/2-inch rod.
  3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
  5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
  6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
  2. NPS 3: 48 inches with 1/2-inch rod.
  3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
  5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.
- I. Install supports for vertical PVC piping every 48 inches.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
  - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.7 IDENTIFICATION

- A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

### 3.8 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.
  - 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 storm drainage 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 storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Test Procedure: Test storm drainage piping 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. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

### 3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris 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.

### 3.10 PIPING SCHEDULE

- A. Aboveground storm drainage piping shall be the following:
  1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.
- B. Underground storm drainage piping shall be either the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221413

## SECTION 221423 - STORM DRAINAGE 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 storm drainage piping specialties:
  - 1. Combination Roof drains
  - 2. Roof Drains
  - 3. Overflow Downspout Nozzles.
- B. Related Sections include the following:
  - 1. Division 22 Section "Sanitary Waste Piping Specialties" for backwater valves, floor drains, trench drains and channel drainage systems connected to sanitary sewer, air admittance valves, and solid interceptors.

## 1.3 SUBMITTALS

- A. Product Data: For roof drains.

## 1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

## 1.5 COORDINATION

- A. Coordinate size and location of roof penetrations.

## PART 2 - PRODUCTS

## 2.1 ROOF DRAINS

- A. Combination Roof Main Drain and Overflow Roof Drain:
  - 1. Basis of Design: Zurn Z163, (2) 15" diameter drain bodies.
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Froet Industries, LLC (100 Series Bi-functional Roof Drain)

- b. Josam Company; Josam Div.
  - c. MIFAB, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
- 3. Standard: ASME A112.21.2M.
  - 4. Pattern: Roof drain.
  - 5. Body Material: Cast iron.
  - 6. Combination Flashing Ring and Gravel Stop: As required.
  - 7. Outlet: Bottom.
  - 8. Dome Material: Cast iron.
  - 9. Extension Collars: Required.
  - 10. Underdeck Clamp: Required.
  - 11. Sump Receiver: Required.
- B. Overflow Downspout Nozzles:
- 1. Basis of Design: Zurn ZAB-199-SS
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - d. Watts Drainage Products Inc.
    - e. Zurn Plumbing Products Group; Specification Drainage Operation.
  - 3. Description: Polished nickel bronze, with no-hub inlet, decorative face of wall flange and outlet nozzle, with stainless steel screen.

## 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 roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.
  - 1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
  - 2. Position roof drains for easy access and maintenance.
- C. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- D. Install Overflow Downspout Nozzles at all overflow roof drain outlets. Locations thru exterior walls indicated on plumbing plans (tagged RWO).

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

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.

END OF SECTION 221423

## SECTION 223500 - DOMESTIC-WATER HEAT EXCHANGERS

## 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. Circulating, storage, domestic-water heat exchangers.
  - 2. Brazed-plate, domestic-water heat exchangers.
  - 3. Domestic-water, heat-exchanger accessories.
  - 4. Domestic-water storage tanks.

## 1.3 SUBMITTALS

- A. Product Data: For each type and size of domestic-water heat exchanger indicated. Include dimensions, weights, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Certified Performance: For each unit, include manufacturer's computer software selection specific to project design conditions.
- C. Wiring Diagrams: For power, signal, and control wiring.
- D. Product Certificates: For each type of domestic-water heat exchanger, from manufacturer.
- E. Domestic-Water, Heat-Exchanger Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For domestic-water heat exchangers to include in emergency, operation, and maintenance manuals.
- I. Warranty: Sample of special warranty.

## 1.4 QUALITY ASSURANCE

- A. Certified Performance: Manufacturer shall assume responsibility for correct sizing of components and assure performance designated in design criteria indicated and as scheduled on the Drawings.

- B. 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.
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- D. ASME Compliance: Where ASME-code construction is indicated, fabricate and label heat-exchanger storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- E. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

## 1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of domestic-water heat exchangers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including heat exchanger, storage tank, and supports.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Periods: From date of Substantial Completion.
    - a. Circulating, Storage, Domestic-Water Heat Exchangers:
      - 1) Storage Tank: Five years.
      - 2) Brazed-Plate Heat Exchanger: One year.
      - 3) Controls and Other Components: One year.
    - b. Compression Tanks: One year.

## PART 2 - PRODUCTS

### 2.1 DOMESTIC-WATER HEAT EXCHANGERS

- A. Circulating, Storage, Domestic-Water Heat Exchangers:
  - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
    - a. Adamson Global Technology Corporation.
    - b. Cemline Corporation.
    - c. Patterson-Kelley; a division of Harsco Corporation.
  - 2. Capacity and Performance: As Scheduled on the Drawings.



3. Description: Packaged, large-capacity, insulated hot-water storage tank with brazed plate heat-exchanger; intra-tank circulator; controls; and specialties for heating domestic water with boiler hot water in heat exchanger.
4. Flow Pattern: Standard-flow arrangement, with water from bottom of storage tank circulated through the heat-exchanger and returned to tank. Include hot-water outlet located at top of tank and temperature sensor in tank.
5. Storage-Tank Construction: ASME-code type 316 stainless steel with 125-psig 150-psig working-pressure rating. Include nozzle and head for heat-exchanger tube coil.
  - a. Configuration: Vertical.
  - b. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing and labeling.
    - 1) Provide tappings for connections, safety devices, and drain.
      - a) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      - b) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
  - c. Lining: None required. Tank shall be constructed of 316 stainless steel complying with NSF 61.
  - d. Insulation: Minimum 3" thickness with minimum 20 gauge steel jacket with baked enamel finish. Comply with ASHRAE/IESNA 90.1, and suitable for operating temperature. Surround entire storage tank and nozzle except connections and controls.
  - e. Anode Rods: Factory installed, magnesium.
6. Brazed Plate Heat-Exchanger: Assembly of heat-exchanger plates, permanently brazed together, for using boiler hot water to heat domestic water.
  - a. Working-Pressure Rating: 150 psig 200 psig minimum.
  - b. Plate Construction: Single wall.
  - c. Plate Material: Stainless steel.
  - d. Connections: Stainless steel, threaded.
  - e. Brazing Filler Metal: Copper or nickel.
7. Temperature Control: Electronically operated modulating 3-way control valve, factory piped, and factory installed and wired electronic adjustable temperature control module. System shall provide close temperature (control by modulating the flow of boiler water through the heat exchanger).
8. Safety Control: Field programmable, digital electronic control with LCD readout and digital thermometer.
9. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger. Select one relief valve with sensing element that extends into storage tank.
10. Gages: Factory-mounted thermometers and pressure gages. Include for both domestic hot water and boiler water.

11. Intra-Tank Circulating Pump: UL 778, all-bronze, centrifugal, overhung-impeller, separately coupled in-line pump as defined in HI 1.1-1.2 and HI 1.3. Include mechanical seals, 125-psig minimum working-pressure rating, and 225 deg F continuous-water-temperature rating. Pump shall be factory piped.
  - a. Pump Control: Sensor for operating pump and control valve.
12. Support: Factory mounted on skids.
13. Energy Management System Interface: Normally closed dry contacts for enabling and disabling.

## 2.2 DOMESTIC WATER STORAGE TANKS

- A. As Scheduled on the Drawings.

## 2.3 DOMESTIC-WATER, HEAT-EXCHANGER ACCESSORIES

- A. Domestic-Water Compression Tanks:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
  - a. AMTROL Inc.
  - b. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
  - c. State Industries.
  - d. Taco, Inc.
2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:
  - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
  - 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. Air-Charging Valve: Factory installed.

- B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1

- C. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than heat-exchanger working-pressure rating. Select relief valves with sensing element that extends into storage tank.

- D. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than heat-exchanger working-pressure rating.

- E. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.

## 2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heat exchangers specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

- B. Hydrostatically test domestic-water heat exchangers to minimum of one and one-half times pressure rating before shipment.
- C. Domestic-water heat exchangers will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.
- D. Prepare test and inspection reports.

### PART 3 - EXECUTION

#### 3.1 DOMESTIC-WATER, HEAT-EXCHANGER INSTALLATION

- A. Domestic-Water, Heat-Exchanger Mounting: Install domestic-water heat exchangers on concrete base. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 5. Anchor heat exchangers to substrate.
- B. Install domestic-water heat exchangers 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.
  - 1. Install shutoff valves on domestic-water-supply piping to heat exchangers and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
  - 2. Install shutoff valves on heating hot-water piping to heat exchangers. Comply with requirements for shutoff valves specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- C. Install temperature and pressure relief valves in top portion of storage-tank shells of domestic-water heat exchangers with domestic-water storage. Use relief valves with sensing elements that extend into shells. Extend 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.
- D. Install heat-exchanger 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 domestic-water heat exchangers that do not have tank drains. Comply with requirements for hose-end drain valves specified in Division 22 Section "Domestic Water Piping Specialties."
- E. Install thermometer on each domestic-water, heat-exchanger, inlet and outlet piping, and install thermometer on each domestic-water, heat-exchanger, heating-fluid inlet and outlet piping. Comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."
- F. Install pressure gages on domestic-water, heat-exchanger, heating-fluid piping. Comply with requirements for pressure gages specified in Division 22 Section "Meters and Gages for Plumbing Piping."

- G. Fill domestic-water heat exchangers with water.
- H. Charge domestic-water compression tanks with air.

### 3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping."
- B. Comply with requirements for heating hot-water piping specified in Division 23 Section "Hydronic Piping."
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to domestic-water heat exchangers, allow space for service and maintenance of heat exchangers. Arrange piping for easy removal of domestic-water heat exchangers.

### 3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Domestic-water heat exchangers will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain domestic-water heat exchangers.

END OF SECTION 223500

## SECTION 224000 - PLUMBING FIXTURES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
  - 1. Water closets.
  - 2. Urinals.
  - 3. Lavatories.
  - 4. Sinks.
  - 5. Showers.
  - 6. Service basins.
  - 7. Water coolers.
  - 8. Protective shielding guards.
  - 9. Fixture supports.
- B. Related Sections include the following:
  - 1. Division 6 Section "Interior Architectural Woodwork" for solid surface fixtures and casework.
  - 2. Division 10 Section "Toilet, Bath, and Laundry Accessories."
  - 3. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, trench drains, and specialty fixtures.

## 1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. 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.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. 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.
  - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
  - 1. Plastic Mop-Service Basins: ANSI Z124.6.
  - 2. Plastic Shower Enclosures: ANSI Z124.2.
  - 3. Slip-Resistant Bathing Surfaces: ASTM F 462.
  - 4. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
  - 5. Vitreous-China Fixtures: ASME A112.19.2M.
  - 6. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
  - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
  - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
  - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
  - 4. Faucets: ASME A112.18.1.
  - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
  - 6. Hose-Coupling Threads: ASME B1.20.7.
  - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  - 8. NSF Potable-Water Materials: NSF 61.
  - 9. Pipe Threads: ASME B1.20.1.
  - 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
  - 11. Supply Fittings: ASME A112.18.1.
  - 12. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for shower faucets:

1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
4. Faucets: ASME A112.18.1.
5. Hand-Held Showers: ASSE 1014.
6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
7. Hose-Coupling Threads: ASME B1.20.7.
8. Manual-Control Antiscald Faucets: ASTM F 444.
9. Pipe Threads: ASME B1.20.1.
10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

J. 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. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Brass Waste Fittings: ASME A112.18.2.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Dishwasher Air-Gap Fittings: ASSE 1021.
2. Floor Drains: ASME A112.6.3.
3. Grab Bars: ASTM F 446.
4. Hose-Coupling Threads: ASME B1.20.7.
5. Off-Floor Fixture Supports: ASME A112.6.1M.
6. Pipe Threads: ASME B1.20.1.
7. Plastic Toilet Seats: ANSI Z124.5.
8. Supply and Drain Protective Shielding Guards: ICC A117.1.

## 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: One year(s) from date of Substantial Completion.

## 1.7 EXTRA MATERIALS

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

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
4. Water-Closet flush valve, repair kits: Equal to 5 percent of amount of each type installed.

5. Toilet Seats: Equal to 5 percent of amount of each type installed.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
  - a. Vitreous China Fixtures:
    - 1) American Standard Companies, Inc.
    - 2) Eljer.
    - 3) Kohler.
    - 4) Zurn.
  - b. Flushometers:
    - 1) Sloan.
    - 2) Toto.
    - 3) Zurn.
  - c. Toilet Seats:
    - 1) Bemis Manufacturing Company.
    - 2) Church Seats.
    - 3) Olsonite Corp.
    - 4) Zurn.
  - d. Fixture Supports
    - 1) Josam Company.
    - 2) MIFAB Manufacturing Inc.
    - 3) Smith, Jay R. Mfg. Co.
    - 4) Tyler Pipe; Wade Div.
    - 5) Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
    - 6) Zurn Plumbing Products Group; Specification Drainage Operation.
  - e. Stainless Steel Sinks:
    - 1) Elkay.
    - 2) Just.
  - f. Faucets:
    - 1) Chicago Faucets.
    - 2) T & S Brass and Bronze Works, Inc.
    - 3) Sloan.
    - 4) Zurn Plumbing Products Group; AquaSpec Commercial Faucet Operation.
  - g. Showers:
    - 1) Acryline USA, Inc.
    - 2) Aquabath.
    - 3) Aquarius.
    - 4) Lasco.
  - h. Shower valves and Controls:
    - 1) Leonard.
    - 2) Powers.
    - 3) Symmons.
    - 4) Zurn.



## 2.2 FIXTURE SCHEDULE

A. WC-1 ADA Water Closet:

1. Wall hung with concealed carrier, vitreous china, 1.6 gpf siphon jet action, elongated rim, top spud, water closet with exposed chrome plated brass flush valve, electronic sensor type dual-flush 1.6/1.1 GPF with manual override button.
  - a. Water closet: Basis of Design: American Standard 2257.103.
  - b. Flushometer: Basis of Design: Sloan ECOS 8111-1.6/1.1
  - c. Open front seat less cover: Equal to Church 9500C.
  - d. Mount Rim 17" above finished floor.
  - e. Fixture and seat finish shall be white.
  - f. Trim and fittings shall be chrome plated finish.
  - g. Floor mounted concealed chair carrier.

B. WC-2 Water Closet:

1. Wall hung with concealed carrier, vitreous china, 1.6 gpf siphon jet action, elongated rim, top spud, water closet with exposed chrome plated brass flush valve, electronic sensor type dual-flush 1.6/1.1 GPF with manual override button.
  - a. Water closet: Basis of Design: American Standard 2257.103.
  - b. Flushometer: Basis of Design: Sloan ECOS 8111-1.6/1.1
  - c. Open front seat less cover: Equal to Church 9500C.
  - d. Mount Rim 14" above finished floor.
  - e. Fixture and seat finish shall be white.
  - f. Trim and fittings shall be chrome plated finish.
  - g. Floor mounted concealed chair carrier.

C. UR-1 ADA Urinal:

1. Vitreous china, wall hung, high efficiency wash out action, ultra low consumption urinal system with integral trap, 3/4" top spud, exposed chrome plated electronic sensor 1/8 GPF.
  - a. Basis of Design: Sloan WEUS 1000.1401-0.13-G2
  - b. Concealed wall carrier as required for fixture arrangement.

D. LAV-1 ADA Wall Hung Lavatory:

1. Wall hung, 4" centers, vitreous china, barrier free lavatory with chair carrier support. Faucet shall be cast brass, 4" center-set, hands-free automatic operation, below deck thermostatic mixing valve, deck mounted spout, 0.5 gpm max. flow restrictor and aerator. Fixture shall be white. Faucet, drain, trim, and fittings shall be chrome plated finish.
  - a. Lavatory: Basis of Design: American Standard 0355.012
  - b. Faucet: Basis of Design: Sloan ETF-600-BDT-EL-154
  - c. Grid Strainer Assembly: Sloan ETF-460-A, chrome plated brass outlet tube.
  - d. Trap: 17 gauge chrome plated brass.
  - e. Concealed arm carrier support.
  - f. Chrome plated supply tubing kit with chrome plated brass loose key stops.
  - g. Provide protective shielding guards on exposed piping.

E. LAV-2 ADA Counter Lavatory:

1. Sink and countertop furnished by Division 6 Section 064023 Interior Architectural Woodwork.
2. Faucet shall be cast brass, 4" center-set, hands-free automatic operation, below deck thermostatic mixing valve, deck mounted spout, 0.5 gpm max. flow restrictor and aerator. Faucet, drain, trim, and fittings shall be chrome plated finish.
  - a. Faucet: Basis of Design: Sloan ETF-600-BDT-EL-154
  - b. Grid Strainer Assembly: Sloan ETF-460-A, chrome plated brass outlet tube.
  - c. Trap: 17 gauge chrome plated brass.
  - d. Concealed arm carrier support.
  - e. Chrome plated supply tubing kit with chrome plated brass loose key stops.
  - f. Protective apron shield furnished by Div 6.
  - g. Coordinate rough-in, connection, and mounting height with Architectural casework.

F. SK-1 Classroom - Single Bowl Sink:

1. 20 ga. Type 304, stainless steel, 6-1/2" deep, self-rimming, 25" x 17" single bowl sink with punching to match faucet and trim. Faucet shall be cast brass, deck mounted, sensor type hands free, with swing spout, 1.5 gpm max. flow aerator. Bubbler shall be lead free brass with flex guard and push button valve. Provide with drain assembly with basket and supply pipe kit with stops. Faucet, drain, trim, and fittings shall be chrome plated finish.
  - a. Package Basis of Design: Elkay CDKA2517C.
    - 1) Faucet Basis of Design: Sloan EBF-750-BDT.
    - 2) Bubbler Basis of Design: Elkay 1141A.
  - b. Mixing Valve: Thermostatic type, below deck, brass body, internal check valves, adjustable temperature range 80-120 deg F.
  - c. 17 Gauge Basket & Strainer Assembly.
  - d. Chrome plated supply tubing kit with chrome plated brass loose key stops.
  - e. Protective apron shield furnished by Div. 6.
  - f. Coordinate rough-in, connection, and mounting height with Architectural casework.

G. SK-2 ADA Cafeteria Sink:

1. Sink and countertop furnished by Division 6 Section 064023 Interior Architectural Woodwork.
2. Faucet shall be cast brass, 4" center-set, hands-free automatic operation, below deck thermostatic mixing valve, deck mounted spout, 0.5 gpm max. flow restrictor and aerator. Faucet, drain, trim, and fittings shall be chrome plated finish.
  - a. Faucet: Basis of Design: Sloan ETF-610-BDT-EL-154
  - b. Grid Strainer Assembly: Sloan ETF-460-A, chrome plated brass outlet tube.
  - c. Trap: 17 gauge chrome plated brass.
  - d. Concealed arm carrier support.
  - e. Chrome plated supply tubing kit with chrome plated brass loose key stops.
  - f. Protective apron shield furnished by Div 6.
  - g. Coordinate rough-in, connection, and mounting height with Architectural casework.

H. SK-3 Art Room Sink:

1. Freestanding floor mount, 14 ga. type 304 stainless steel welded square corner construction, tubular adjustable legs, single compartment 14" deep x 45" inside length x 24" inside width, with 8" high integral backsplash with hole punching to match faucet. Faucet shall be backsplash mounting type, cast brass with wrist blade handles with index, 9-1/2" tubular brass swing spout, and 1.5 gpm max. flow aerator. Provide with drain assembly with basket and supply pipe kit with stops. Faucet, drain, trim, and fittings shall be chrome plated finish.
  - a. Sink: Basis of Design: Elkay SS8145
  - b. Faucet: Basis of Design: Zurn Z842J4-HCT-17F.
  - c. 17 Gauge Basket & Strainer Assembly.
  - d. Chrome plated supply tubing kit with chrome plated brass loose key stops.

I. SK-4 ADA Faculty Single Bowl Kitchen Sink:

1. 18 ga. Type 304, stainless steel, 6-1/2" deep, self-rimming, 22" x 19" single bowl sink with punching to match faucet. Faucet shall be cast brass, wrist blade handles, deck mounted, with spray, swing spout, 1.5 gpm max. flow aerator. Provide with drain assembly with basket and supply pipe kit with stops. Faucet, drain, trim, and fittings shall be chrome plated finish.
  - a. Sink: Basis of Design: Elkay LRAD2219.
  - b. Faucet: Basis of Design: Zurn Z871B4-HCT-HS-17F.
  - c. 17 Gauge Basket & Strainer Assembly.
  - d. Chrome plated supply tubing kit with chrome plated brass loose key stops.
  - e. Protective apron shield furnished by Div. 6

J. SK-5 Service Sink:

1. Floor mounted, freestanding type, composite, with four legs, and 26" x 22" x 14" deep bowl. Sink shall be white. Faucet shall be 4" centerset deck mounted cast brass, with lever blade handles, vacuum breaker spout and hose thread outlet.
  - a. Sink: Basis of Design: Zurn MS2622.

- b. Faucet: Basis of Design: Zurn Z812N1.
- c. Chrome plated supply tubing kit with chrome plated brass loose key stops.

K. SK-6 Single Bowl Sink:

- 1. 18 ga. Type 304, stainless steel, 6-1/2" deep, self-rimming, 22" x 19" single bowl sink with punching to match faucet. Faucet shall be cast brass, wrist blade handles, deck mounted, swing spout, 1.5 gpm max. flow aerator. Provide with drain assembly with basket and supply pipe kit with stops. Faucet, drain, trim, and fittings shall be chrome plated finish.
  - a. Sink: Basis of Design: Elkay LRAD2219.
  - b. Faucet: Basis of Design: Zurn Z871B4-HCT-17F.
  - c. 17 Gauge Basket & Strainer Assembly.
  - d. Chrome plated supply tubing kit with chrome plated brass loose key stops.
  - e. Protective apron shield furnished by Div. 6.

L. SK-7 Music Room Sink:

- 1. Freestanding floor mount, 14 ga. type 304 stainless steel welded square corner construction, tubular adjustable legs, single compartment 14" deep x 45" inside length x 24" inside width, with 8" high integral backsplash with hole punching to match faucet. Faucet shall be backsplash mounting type, cast brass with wrist blade handles with index, 9-1/2" tubular brass swing spout, and 1.5 gpm max. flow aerator. Provide with drain assembly with basket and supply pipe kit with stops. Faucet, drain, trim, and fittings shall be chrome plated finish.
  - a. Sink: Basis of Design: Elkay SS8145
  - b. Faucet: Basis of Design: Zurn Z842J4-HCT-17F.
  - c. 17 Gauge Basket & Strainer Assembly.
  - d. Chrome plated supply tubing kit with chrome plated brass loose key stops.

M. SH-1 ADA Shower:

- 1. Field-built shower tile walls furnished and installed under Div. 9 Finishes.
- 2. Field-built shower bath accessories furnished and installed under Div. 10 Specialties.
- 3. Base: Precast terrazzo made of marble chips in Portland cement, integral sloped threshold with stainless steel cap, integral tiling flanges, cast integral stainless steel drain with removable strainer.
  - a. Basis of Design: Stern Williams Parian Transfer Model WDA-3600, 39"x39".
- 4. Valve: pressure balancing mixing valve, wall/hand shower.
  - a. Basis of Design: Symmons 1-117-FS Series.

N. SH-2 ADA Shower:

- 1. Acrylic one piece molded construction, roll-in / transfer stall ADA compliant unit. Provide factory installed options stainless steel grab bars and curtain rod, fold up seat, self caulking brass drain with stainless steel strainer. Fixture shall be white. Coordinate left hand/right hand drain configuration.
  - a. Cabinet Basis of Design: AquaBath C6536BF-FUS, 3/4" dam height.
- 2. Valve: pressure balancing mixing valve, wall/hand shower.
  - a. Basis of Design: Symmons 1-117-FS Series.

O. MR-1 Mop Sink:

- 1. Floor mounted, 24" x 24" x 10" deep, molded stone sink. Wall mounted 8" center faucet with vacuum breaker, lever blade handles, pail hook, and wall brace. Provide with accessories as indicated below. Fixture finish shall be white. Faucet, drain, trim, and fittings shall be chrome plated finish.
  - a. Fixture Basis of Design: Z1996-24-HH-MH-SD-WG
  - b. Faucet Basis of Design: Zurn 842M1
  - c. Strainer: 3" stainless steel drain
  - d. Accessories: Mop hanger, hose and bracket, stainless steel wall guards.

P. EWC: Electric Water Cooler:

- 1. Bi-level, barrier free, electric refrigerated, wall mounted, with recessed chiller. Oval fountains with brushed stainless steel finish.

- a. Basis of Design: Halsey Taylor OVL-II-SER-Q

### 2.3 SENSOR POWER CONVERTERS

- A. Hardwired power converter (120VAC to 6VDC) to power up to 10 sensor urinal/water closet flush valves or up to 8 sensor faucets. Device shall mount to junction box.
- B. Coordinate quantity required for single, grouped, and gang toilet rooms. Group individual adjacent toilet room (maximum four toilet rooms) on a single power converter.

### 2.4 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
1. Josam Company.
  2. MIFAB Manufacturing Inc.
  3. Smith, Jay R. Mfg. Co.
  4. Tyler Pipe; Wade Div.
  5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
  6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Water-Closet Supports:
1. Description: Combination carrier designed for accessible and standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
- C. Urinal Supports:
1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
  2. Accessible-Fixture Support: Include rectangular steel uprights.
- D. Lavatory Supports:
1. Type II, lavatory carrier with concealed arms and tie rod. Accessible-Fixture Support: Include rectangular steel uprights.
  2. Accessible-Fixture Support: Include rectangular steel uprights.
- E. Sink Supports:
1. Description: Type I, sink carrier with exposed arms and tie rods II, sink carrier with hanger plate, bearing studs, and tie rod for sink-type fixture. Include steel uprights with feet.

### 2.5 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Guard: Manufactured plastic enclosure for covering for hot- and cold-water supplies and trap and drain piping and complying with ADA requirements.

1. Available Manufacturers:
  - a. Trubro

### 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.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
  1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounting fixtures in and attached to casework.
- H. Install fixtures level and plumb according to roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

- N. Install toilet seats on water closets.
- O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- Q. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- R. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- S. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- T. Install disposer in outlet of each sink indicated to have disposer.
- U. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install in sink deck. Connect inlet hose to dishwasher and outlet hose to disposer.
- V. 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."
- W. Set bathtubs shower receptors and service basins in leveling bed of cement grout.
- X. 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.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 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.
- E. Install fresh batteries in sensor-operated mechanisms.

### 3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.
- D. Install fresh batteries in sensor-operated mechanisms.

### 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.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect 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 unless approved in writing by Owner.

END OF SECTION 224000

## SECTION 224500 - EMERGENCY 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 emergency plumbing fixtures:
  - 1. Eye/Face wash units.
  - 2. Drench hose units.
  - 3. Water-tempering equipment.
- B. Related Sections include the following:
  - 1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.
  - 2. Division 22 Section "Sanitary Waste Piping Specialties" for floor drains.

## 1.3 DEFINITIONS

- A. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- B. Tepid: Moderately warm.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.
- B. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For emergency plumbing fixtures to include in maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."
- B. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.



## PART 2 - PRODUCTS

## 2.1 EYE/FACE WASH EQUIPMENT

## A. Eye/Face Wash Equipment, (Tagged EE-1):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Encon Safety Products.
  - b. Guardian Equipment Co. (Basis of Design: G1774)
  - c. WaterSaver Faucet Co.
2. Description: Plumbed, adjacent-to-sink, swivel, counter-mounting eye/face wash equipment.
  - a. Capacity: Deliver potable water at rate not less than 3.0 gpm for at least 15 minutes.
  - b. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open valve.
  - c. Control-Valve Actuator: Swinging action of head assembly opens plug valve integral with unit.

## B. Eye/Face Wash Drench Hose Station , (Tagged EE-2):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Encon Safety Products.
  - b. Guardian Equipment Co. (Basis of Design)
  - c. WaterSaver Faucet Co.
2. Description: Wall mounted, exposed, eye/face wash/drench hose with two spray type outlet heads, squeeze valve, 12' coiled hose, wall bracket, and backflow preventer.
  - a. Eye/face wash / drench hose equal to Guardian Equipment G5046BP-DC-TMV.
  - b. Spray head assembly with "flip-top" individual stainless steel dust covers for each head, internal flow control valve and filter.
  - c. Chrome plated brass squeeze valve operator, with hands free locking clip.
  - d. ANSI compliant identification sign.
  - e. Thermostatic mixing valve.

## 2.2 WATER-TEMPERING EQUIPMENT

## A. Water-Tempering Equipment, (Tagged MV)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Encon Safety Products.
  - b. Guardian Equipment.
  - c. Haws Corporation.
  - d. Lawler Manufacturing Co., Inc.
  - e. Leonard Valve Company.

2. Performance and Capacity: As Scheduled on the Drawings.
3. Description: Factory-fabricated, hot- and cold-water-tempering equipment with thermostatic mixing valve.
  - a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
  1. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.
- D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- E. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Dielectric fittings are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Thermometers are specified in Division 22 Section "Meters and Gages for Plumbing Piping."
- G. Install equipment nameplates or equipment markers on fixtures and equipment signs on water-tempering equipment. Identification materials are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

#### 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 hot- and cold-water-supply piping to hot- and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.

3.4 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.
- B. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.
- C. Report test results in writing.

3.5 ADJUSTING

- A. Adjust equipment temperature settings.

END OF SECTION 224500

## SECTION 230500 - COMMON WORK RESULTS FOR HVAC

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. RELATED SECTIONS
- C. Division 1 Section 019113 "General Commissioning Requirements".

## 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. Concrete bases.
  - 10. Supports and anchorages.

## 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct 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 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. 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.

#### 1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.

B. Welding certificates.

#### 1.5 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. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### 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 HVAC 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 HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

## 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.

## 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

## 2.3 JOINING MATERIALS

- A. Refer to individual Division 23 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 maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch 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.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
  - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

## 2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- B. 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.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

## 2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

## 2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Sealing Elements: EPDM 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. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.7 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

## 2.8 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, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.
- D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- E. Split-Plate, Stamped-Steel Type: With hinge, 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 23 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.
- F. Install piping 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. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
- M. Sleeves are not required for core-drilled holes.
- N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.



- O. 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 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 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.
  - 4. 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.
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. 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.
- Q. 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 "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. 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 23 Sections 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. Brazed Joints: Construct joints according to AWS's "Braze Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

- F. 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 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.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. 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 Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

### 3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 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 HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.5 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- B. All painting of exposed utilities in finished spaces by others. Refer to Division 9 Painting Sections. Coordinate with areas as indicated on the Mechanical drawings and Architectural Reflected Ceiling and Finish Plans.

### 3.6 CONCRETE BASES

- 1. Concrete Bases: Housekeeping pads furnished and installed by others. Refer to Division 3 Concrete. Coordinate sizes and locations of housekeeping pads based on approved equipment shop drawings and submittals.

### 3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### 3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

END OF SECTION 230500

## SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC 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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

## 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

## PART 2 - PRODUCTS

## 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

## 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

## 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.

- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

#### 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

#### 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.

4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

## SECTION 230519 - METERS AND GAGES FOR HVAC 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.
  - 3. Test plugs.

## 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.
- B. Shop Drawings: Schedule for thermometers gages indicating manufacturer's number, scale range, and location for each.
- C. Product Certificates: For each type of thermometer gage, signed by product manufacturer.

## PART 2 - PRODUCTS

## 2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- 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. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div
  - 2. Trerice, H. O. Co.
  - 3. Weiss Instruments, Inc.
- B. Case: Die-cast aluminum Die-cast aluminum or brass, 9 inches long.
- C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.

- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. 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 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

## 2.3 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. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
  - 2. Trerice, H. O. Co.
  - 3. Weiss Instruments, Inc.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
  - 1. Case: Dry type, drawn steel or cast aluminum, 3" diameter.
  - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
  - 3. Pressure Connection: Brass, NPS 1/4, 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.
  - 8. Ring: Metal.
  - 9. Accuracy: Grade B, plus or minus 2 percent of middle half scale.
  - 10. Range for Fluids under Pressure: Two times operating pressure.
- C. Pressure-Gage Fittings:
  - 1. Valves: NPS 1/4 brass or stainless-steel needle type.
  - 2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
  - 3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

## 2.4 TEST PLUGS



- A. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- B. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- C. Core Inserts: One or two self-sealing rubber valves.
  - 1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
  - 2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.
- D. Test Kit: Furnish one test kit(s) containing one pressure gage and adaptor, one thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
  - 1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
  - 2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
  - 3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
  - 4. Carrying case shall have formed instrument padding.

### PART 3 - EXECUTION

#### 3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the following locations:
  - 1. Install in locations as indicated in schematics, details, and drawings.
    - a. Inlet and outlet of each hydronic boiler.
- B. Provide the following temperature ranges for thermometers:
  - 1. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.

#### 3.2 GAGE APPLICATIONS

- A. Install in locations as indicated in schematics, details, and drawings.
  - 1. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.
  - 2. Install dry-case-type pressure gages at chilled water inlets and outlets of chiller.
  - 3. Install dry-case-type pressure gages at suction and discharge of each pump.

#### 3.3 INSTALLATIONS

- A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees where thermometers are indicated.
- B. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- C. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).

- D. Install test plugs in tees in piping.

#### 3.4 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

END OF SECTION 230519

## SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC 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. Brass ball valves.
  - 2. Iron, single-flange butterfly valves.
  - 3. Bronze swing check valves.
  - 4. Iron swing check valves.
  - 5. Bronze gate valves.
  - 6. Iron gate valves.
  - 7. Chainwheels.
- B. Related Sections:
  - 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
  - 2. Division 23 Section "Identification for HVAC 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. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. 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 B31.9 for building services piping valves.

## 1.6 DELIVERY, STORAGE, AND HANDLING

## A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

## B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

## C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

## PART 2 - PRODUCTS

## 2.1 GENERAL REQUIREMENTS FOR VALVES

## A. Refer to HVAC 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. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller.
3. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

## E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. 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.
3. Butterfly Valves: With extended neck.

## F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.

2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

## 2.2 MANUFACTURERS

A. 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. Conbraco Industries, Inc.; Apollo Valves.
2. Crane Co.; Crane Valve Group; Crane Valves.
3. Crane Co.; Crane Valve Group; Jenkins Valves.
4. Hammond Valve.
5. Milwaukee Valve Company.
6. Nibco, Inc.
7. Watts.

## 2.3 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Two piece.
  - e. Body Material: Forged brass.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.
  - h. Stem: Brass.
  - i. Ball: Chrome-plated brass.
  - j. Port: Full.

## 2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Description:
  - a. Standard: MSS SP-67, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
  - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
  - e. Seat: EPDM.
  - f. Stem: One- or two-piece stainless steel.
  - g. Disc: Aluminum bronze.

## 2.5 BRONZE SWING CHECK VALVES

## A. Class 125, Bronze Swing Check Valves with Bronze Disc:

## 1. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

## 2.6 IRON SWING CHECK VALVES

## A. Class 125, Iron Swing Check Valves with Metal Seats:

## 1. Description:

- a. Standard: MSS SP-71, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

## 2.7 BRONZE GATE VALVES

## A. Class 125, RS Bronze Gate Valves:

## 1. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron.

## 2.8 IRON GATE VALVES

## A. Class 125, OS&amp;Y, Iron Gate Valves:

## 1. Description:

- a. Standard: MSS SP-70, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

## 2.9 CHAINWHEELS

- 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. Babbitt Steam Specialty Co.
  - 2. Roto Hammer Industries.
  - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
  - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
  - 2. Attachment: For connection to ball butterfly valve stems.
  - 3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc coating.
  - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

## 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 chainwheels on operators for butterfly and gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.

### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, butterfly, or gate valves.
  - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
  - 3. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check 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 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
  - 4. For Steel Piping, NPS 2-1/2 and larger: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 5. For Grooved-End Steel Piping: Valve ends may be grooved.

### 3.5 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
  - 1. Ball Valves: Two piece, full port, brass or with bronze trim.
  - 2. Bronze Swing Check Valves: Class 125, bronze disc.
  - 3. Bronze Gate Valves: Class 125, RS.
- B. Pipe NPS 2-1/2 and Larger:
  - 1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
  - 2. Iron Swing Check Valves: Class 125, metal seats.
  - 3. Iron Gate Valves: Class 125, OS&Y.

END OF SECTION 230523



## SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC 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. This Section includes the following hangers and supports for HVAC system piping and equipment:
  - 1. Steel pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
  - 4. Thermal-hanger shield inserts.
  - 5. Fastener systems.
  - 6. Pipe stands.
  - 7. Equipment supports.
- B. Related Sections include the following:
  - 1. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
  - 2. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

## 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

## 1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

## 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.
  - 2. Thermal-hanger shield inserts.
  - 3. Equipment supports.

- B. Welding certificates.

## 1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

## 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.

### 2.2 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. Grinnell Corp.
  - 4. National Pipe Hanger Corporation.
  - 5. Piping Technology & Products, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

### 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from 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. Thomas & Betts Corporation.
  - 3. Unistrut Corp.; Tyco International, Ltd.

- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

## 2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.6 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
  - 1. Vertical Members: Two or more protective-coated-steel channels.
  - 2. Horizontal Member: Protective-coated-steel channel.
  - 3. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

## 2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

## 2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## 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. 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.
  - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
  - 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
- F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  - 3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
- H. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
  - 3. C-Clamps (MSS Type 23): For structural shapes.
  - 4. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
- I. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  2. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- J. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- K. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

### 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. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at

changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- N. 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. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. 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 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
  - 5. Insert Material: Length at least as long as protective shield.
  - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

## SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC 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. This Section includes the following:
  - 1. Isolation pads.
  - 2. Spring isolators.
  - 3. Spring and elastomeric hangers.
  - 4. Steel and inertia, vibration isolation equipment bases.

## 1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Design Criteria:
  - 1. Mechanical Piping and Equipment components are exempt from the requirements of ASCE 7 Chapter 13 Seismic Design for Nonstructural Components.
  - 2. Refer to Structural General Notes Sheet S100.
  - 3. Building Occupancy Category: III
  - 4. Site Class: D
  - 5. Seismic Design Category: B

## 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

## PART 2 - PRODUCTS



## 2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
  2. Kinetics Noise Control.
  3. Mason Industries.
- B. Isolation Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern, and factory cut to sizes that match requirements of supported equipment.
1. Basis of Design: Mason Industries Super W Pads
  2. Resilient Material: Oil- and water-resistant neoprene.
- C. Spring Isolators: Freestanding, laterally stable, unhooded, open-spring isolators.
1. Basis of Design: Mason Industries SLFH.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
  7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- D. Spring and Neoprene Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Basis of Design: Mason Industries 30N
  2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 5.
  6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 7.
  8. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  9. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
  10. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

## 2.2 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amber/Booth Company, Inc.
  - 2. Kinetics Noise Control.
  - 3. Mason Industries.
  
- B. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
  - 1. Basis of Design: Mason Industries KSL, 6" base depth.
  - 2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
  - 3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
  - 4. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
  - 5. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer. Coordinate with approved pump submittals.

## 2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
  - 1. Powder coating on springs and housings.
  - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
  - 3. Baked enamel or powder coat for metal components on isolators for interior use.
  - 4. Color-code or otherwise mark vibration isolation -control devices to indicate capacity range.

## PART 3 - EXECUTION

### 3.1 COORDINATION

- A. Coordinate all vibration isolation devices with approved mechanical equipment submittals.

### 3.2 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
  
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

### 3.4 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

### 3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

### 3.6 HVAC VIBRATION-CONTROL DEVICE SCHEDULE

- A. Air Handling Units
  1. Isolation Pads:  $\frac{3}{4}$ " thick.
  2. Isolators: Open spring isolators for all supply and return fans, 2" deflection (furnished with equipment).
- B. Energy Recovery Units
  1. Pads:  $\frac{3}{4}$ " thick.
- C. Base Mounted Pumps
  1. Base: Concrete filled inertia base.
  2. Isolators: Open spring isolators, 1.5" deflection.
- D. Piping within 100 ft of Base Mounted Pumps
  1. Isolators: Spring and Elastomeric Hangers, 1" deflection.
- E. Condensing Units (except CU-5)
  1. Isolators: Open spring isolators, 2" deflection (furnished with equipment).
- F. Kitchen Equipment Condensing Units
  1. Isolation Pads:  $\frac{3}{4}$ " thick.
- G. Suspended Inline Fans
  1. Isolators: Spring and Elastomeric Hangers, 1" deflection.

- H. Suspended Fan Coil Units
  - 1. Isolators: Spring and Elastomeric Hangers, 1" deflection.

END OF SECTION 230548

## SECTION 230553 - IDENTIFICATION FOR HVAC 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. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. 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. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

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.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, 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 rivets or self-tapping screws.

B. 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.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

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.

#### 2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  2. Fasteners: Brass wire-link chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch 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.

#### 2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  1. Size: 3 by 5-1/4 inches minimum.
  2. Fasteners: Brass grommet and wire.
  3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  4. Color: Yellow background with black lettering.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and 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 along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

#### 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 HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

#### 3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553



## SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

## 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 TAB to produce design objectives for the following:
  - 1. Air Systems
  - 2. Hydronic Piping Systems:
  - 3. HVAC equipment quantitative-performance settings.
  - 4. Verifying that automatic control devices are functioning properly.
  - 5. Reporting results of activities and procedures specified in this Section.

## 1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- F. Report Forms: Test data sheets for recording test data in logical order.
- G. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- H. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- I. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

- J. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- K. TAB: Testing, adjusting, and balancing.
- L. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- M. Test: A procedure to determine quantitative performance of systems or equipment.
- N. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

#### 1.4 SUBMITTALS

- A. Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 2 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Sample Report Forms: Submit two sets of sample TAB report forms.
- F. Warranties specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm specializing in Testing, Adjusting, and Balancing of systems and equipment specified in this section and with minimum 5 years documented experience. TAB firm must follow one or a combination of ASHRAE, AABC, TABB, NEEB, or SMACNA procedures and use standard report forms.
  - 1. TAB Firm shall be one of the following:
    - a. Best Environmental Systems Technologies.
    - b. Central Air Balance.
    - c. Maine Air Balance.
    - d. Yankee Balancing.
- B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

- C. TAB Report Forms: Use standard forms from TAB firm's forms.
- D. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."
- E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
  - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

#### 1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

#### 1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

#### 1.8 WARRANTY

- A. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
  - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
  - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

#### PART 2 - PRODUCTS (Not Applicable)

#### PART 3 - EXECUTION

##### 3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
  - 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
  - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract

Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- P. Examine system pumps to ensure absence of entrained air in the suction piping.
- Q. Examine equipment for installation and for properly operating safety interlocks and controls.
- R. Examine automatic temperature system components to verify the following:
  - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
  - 2. Dampers and valves are in the position indicated by the controller.

3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
  4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
  5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
  6. Sensors are located to sense only the intended conditions.
  7. Sequence of operation for control modes is according to the Contract Documents.
  8. Controller set points are set at indicated values.
  9. Interlocked systems are operating.
  10. Changeover from heating to cooling mode occurs according to indicated values.
- S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Permanent electrical power wiring is complete.
  2. Hydronic systems are filled, clean, and free of air.
  3. Automatic temperature-control systems are operational.
  4. Equipment and duct access doors are securely closed.
  5. Balance, smoke, and fire dampers are open.
  6. Isolating and balancing valves are open and control valves are operational.
  7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  8. Windows and doors can be closed so indicated conditions for system operations can be met.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling unit components.
- K. Check for proper sealing of air duct system.

### 3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
  - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
  - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.

5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
  6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### 3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
  2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  3. Measure total system airflow. Adjust to within indicated airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
  - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
  - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

### 3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
  1. Open all manual valves for maximum flow.
  2. Check expansion tank liquid level.
  3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
  4. Check flow-control valves for specified sequence of operation and set at indicated flow.
  5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
  6. Set system controls so automatic valves are wide open to heat exchangers.
  7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
  8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

### 3.8 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
  1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.



2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
  3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
  4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
1. Determine the balancing station with the highest percentage over indicated flow.
  2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
  3. Record settings and mark balancing devices.
- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

### 3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems

### 3.10 PROCEDURES FOR HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check the setting and operation of safety and relief valves. Record settings.

### 3.11 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

### 3.12 PROCEDURES FOR BOILERS

- A. Measure entering- and leaving-water temperatures and water flow.

### 3.13 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

- B. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

### 3.14 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

### 3.15 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.

- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

### 3.16 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
  - 2. Air Outlets and Inlets: 0 to minus 10 percent.
  - 3. Heating-Water Flow Rate: 0 to minus 10 percent.
  - 4. Cooling-Water Flow Rate: 0 to minus 5 percent.

### 3.17 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.18 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
1. Pump curves.
  2. Fan curves.
  3. Manufacturers' test data.
  4. Field test reports prepared by system and equipment installers.
  5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
  2. Name and address of TAB firm.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB firm who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer, type size, and fittings.
  14. Notes to explain why certain final data in the body of reports varies from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outside-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.
  6. Balancing stations.
  7. Position of balancing devices.

## F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:
  - a. Unit identification.
  - b. Location.
  - c. Make and type.
  - d. Model number and unit size.
  - e. Manufacturer's serial number.
  - f. Unit arrangement and class.
  - g. Discharge arrangement.
  - h. Sheave make, size in inches, and bore.
  - i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
  - j. Number of belts, make, and size.
  - k. Number of filters, type, and size.
2. Motor Data:
  - a. Make and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
  - a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan rpm.
  - d. Discharge static pressure in inches wg.
  - e. Filter static-pressure differential in inches wg.
  - f. Preheat coil static-pressure differential in inches wg.
  - g. Cooling coil static-pressure differential in inches wg.
  - h. Heating coil static-pressure differential in inches wg.
  - i. Outside airflow in cfm.
  - j. Return airflow in cfm.
  - k. Outside-air damper position.
  - l. Return-air damper position.

## G. Apparatus-Coil Test Reports:

1. Coil Data:
  - a. System identification.
  - b. Location.
  - c. Coil type.
  - d. Number of rows.
  - e. Fin spacing in fins per inch o.c.
  - f. Make and model number.
  - g. Face area in sq. ft..
  - h. Tube size in NPS.
  - i. Tube and fin materials.
  - j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
  - a. Airflow rate in cfm.
  - b. Average face velocity in fpm.
  - c. Air pressure drop in inches wg.
  - d. Outside-air, wet- and dry-bulb temperatures in deg F.
  - e. Return-air, wet- and dry-bulb temperatures in deg F.
  - f. Entering-air, wet- and dry-bulb temperatures in deg F.
  - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
  - h. Water flow rate in gpm.
  - i. Water pressure differential in feet of head or psig.
  - j. Entering-water temperature in deg F.
  - k. Leaving-water temperature in deg F.
  
- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
  1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.
    - e. Manufacturer's serial number.
    - f. Arrangement and class.
    - g. Sheave make, size in inches, and bore.
    - h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
  
  2. Motor Data:
    - a. Make and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    - g. Number of belts, make, and size.
  
  3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Suction static pressure in inches wg.
  
- I. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
  1. Report Data:
    - a. System and air-handling unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.

- f. Duct area in sq. ft..
- g. Indicated airflow rate in cfm.
- h. Indicated velocity in fpm.
- i. Actual airflow rate in cfm.
- j. Actual average velocity in fpm.
- k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:

- 1. Unit Data:
  - a. System and air-handling unit identification.
  - b. Location and zone.
  - c. Test apparatus used.
  - d. Area served.
  - e. Air-terminal-device make.
  - f. Air-terminal-device number from system diagram.
  - g. Air-terminal-device type and model number.
  - h. Air-terminal-device size.
  - i. Air-terminal-device effective area in sq. ft..
- 2. Test Data (Indicated and Actual Values):
  - a. Airflow rate in cfm.
  - b. Air velocity in fpm.
  - c. Preliminary airflow rate as needed in cfm.
  - d. Preliminary velocity as needed in fpm.
  - e. Final airflow rate in cfm.
  - f. Final velocity in fpm.
  - g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

- 1. Unit Data:
  - a. System and air-handling unit identification.
  - b. Location and zone.
  - c. Room or riser served.
  - d. Coil make and size.
  - e. Flowmeter type.
- 2. Test Data (Indicated and Actual Values):
  - a. Airflow rate in cfm.
  - b. Entering-water temperature in deg F.
  - c. Leaving-water temperature in deg F.
  - d. Water pressure drop in feet of head or psig.
  - e. Entering-air temperature in deg F.
  - f. Leaving-air temperature in deg F.

L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

- 1. Unit Data:

- a. Unit identification.
  - b. Location.
  - c. Service.
  - d. Make and size.
  - e. Model and serial numbers.
  - f. Water flow rate in gpm.
  - g. Water pressure differential in feet of head or psig.
  - h. Pump rpm.
  - i. Impeller diameter in inches.
  - j. Motor make and frame size.
  - k. Motor horsepower and rpm.
  - l. Voltage at each connection.
  - m. Amperage for each phase.
  - n. Full-load amperage and service factor.
  - o. Seal type.
2. Test Data (Indicated and Actual Values):
- a. Static head in feet of head or psig.
  - b. Pump shutoff pressure in feet of head or psig.
  - c. Actual impeller size in inches.
  - d. Full-open flow rate in gpm.
  - e. Full-open pressure in feet of head or psig.
  - f. Final discharge pressure in feet of head or psig.
  - g. Final suction pressure in feet of head or psig.
  - h. Final total pressure in feet of head or psig.
  - i. Final water flow rate in gpm.
  - j. Voltage at each connection.
  - k. Amperage for each phase.

M. Boiler Test Reports:

1. Unit Data:
  - a. Unit identification.
  - b. Location.
  - c. Service.
  - d. Make and type.
  - e. Model and serial numbers.
  - f. Fuel type and input in Btuh.
  - g. Number of passes.
  - h. Ignition type.
  - i. Burner-control types.
  - j. Voltage at each connection.
  - k. Amperage for each phase.
2. Test Data (Indicated and Actual Values):
  - a. Operating pressure in psig.
  - b. Operating temperature in deg F.
  - c. Entering-water temperature in deg F.
  - d. Leaving-water temperature in deg F.
  - e. Number of safety valves and sizes in NPS.
  - f. Safety valve settings in psig.
  - g. High-limit setting in psig.
  - h. Operating-control setting.



- i. High-fire set point.
- j. Low-fire set point.
- k. Voltage at each connection.
- l. Amperage for each phase.
- m. Manifold pressure in psig.

N. Air-to-Air Heat-Recovery Unit Reports:

1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Service.
- d. Make and type.
- e. Model and serial numbers.

2. Motor Data:

- a. Make and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

3. If fans are an integral part of the unit, include the following for each fan:

- a. Make and type.
- b. Arrangement and size.
- c. Sheave make, size in inches, and bore.
- d. Sheave dimensions, center-to-center, and amount of adjustments in inches.

4. Test Data (Indicated and Actual Values):

- a. Total exhaust airflow rate in cfm.
- b. Outside airflow rate in cfm.
- c. Total exhaust fan static pressure in inches wg.
- d. Total outside-air fan static pressure in inches wg.
- e. Exhaust air temperature entering in deg F.
- f. Exhaust air temperature leaving in deg F.
- g. Outside-air temperature entering in deg F.
- h. Outside-air temperature leaving in deg F.

O. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.19 INSPECTIONS

## A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:
  - a. Measure airflow of at least 10 percent of air outlets.
  - b. Measure water flow of at least 5 percent of terminals.
  - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
  - d. Measure sound levels at two locations.
  - e. Measure space pressure of at least 10 percent of locations.
  - f. Verify that balancing devices are marked with final balance position.
  - g. Note deviations to the Contract Documents in the Final Report.

## B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

## 3.20 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

## SECTION 230700 - HVAC 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. Fire-rated insulation systems.
  - 3. Insulating cements.
  - 4. Adhesives.
  - 5. Lagging adhesives.
  - 6. Sealants.
  - 7. Factory-applied jackets.
  - 8. Field-applied jackets.
  - 9. Tapes.
  - 10. Securements.
- B. Related Sections:
  - 1. Division 22 Section "Plumbing Insulation."

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets.
- B. Qualification Data: For qualified Installer.
- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program.
- 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.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 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 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork 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.

### PART 2 - PRODUCTS

#### 2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. 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, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

- D. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Duct Wrap.
    - d. Owens Corning; All-Service Duct Wrap.
- E. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Johns Manville; 800 Series Spin-Glas.
    - c. Knauf Insulation; Insulation Board.
    - d. Owens Corning; Fiberglas 700 Series.
- F. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Johns Manville; Micro-Lok.
    - b. Knauf Insulation; 1000 Pipe Insulation.
    - c. Owens Corning; Fiberglas Pipe Insulation.
  2. Type I, 850 deg F 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.
- G. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; CrimpWrap.
    - b. Johns Manville; MicroFlex.
    - c. Knauf Insulation; Pipe and Tank Insulation.
    - d. Owens Corning; Fiberglas Pipe and Tank Insulation.

## 2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; FlameChek.
    - b. Johns Manville; Firetemp Wrap.
    - c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
    - d. Thermal Ceramics; FireMaster Duct Wrap.
    - e. 3M; Fire Barrier Wrap Products.

## 2.3 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

## 2.4 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

## 2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
  - 1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
  - 2. Service Temperature Range: Minus 50 to plus 180 deg F.
  - 3. Color: White.

## 2.6 SEALANTS

- A. Joint Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Permanently flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 100 to plus 300 deg F.
  - 4. Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

C. ASJ Flashing Sealants, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

## 2.7 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.

## 2.8 FIELD-APPLIED JACKETS

A. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Johns Manville; Zeston.
  - b. Proto PVC Corporation; LoSmoke.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

## 2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

## 2.10 SECUREMENTS

A. Bands:

1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Wire: 0.062-inch soft-annealed, galvanized steel.

## 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.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, 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, duct system, 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 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- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and 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 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 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.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  2. Pipe: Install insulation continuously through floor penetrations.
  3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

### 3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
  2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  3. Protect exposed corners with secured corner angles.
  4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    - a. Do not weld anchor pins to ASME-labeled pressure vessels.
    - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    - d. Do not overcompress insulation during installation.
    - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    - f. Impale insulation over anchor pins and attach speed washers.
    - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.

6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
  7. Stagger joints between insulation layers at least 3 inches.
  8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
  9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
  10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
  2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
  2. Fabricate boxes from galvanized steel, at least 0.050 inch thick.
  3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

### 3.6 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.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and 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 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.

### 3.7 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.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

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 recommended adhesive to 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.

### 3.8 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 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 Flanges:

1. Install preformed 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 mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
  3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  4. Install insulation to flanges as specified for flange insulation application.
- E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
  - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

### 3.10 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Coordinate fire-rated insulation installation with other trades. Grease ducts must be tested and accepted prior to concealing or applying insulation.
- B. Install fire-rated insulation systems in strict accordance with manufacturers written installation instructions to maintain integrity of system.
- C. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

- D. Insulate duct access panels and doors to achieve same fire rating as duct.
- E. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

### 3.11 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system as specified in Division 09 painting Sections.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.12 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply ducts.
  - 2. Outdoor-air ducts.
  - 3. Outdoor-air and Exhaust air plenums.
  - 4. Energy Recovery Unit exhaust duct between unit outlet and penetration of building exterior.
  - 5. General Exhaust ducts between isolation damper and penetration of building exterior.
  - 6. Kitchen (Grease) Exhaust ducts.
  - 7. Indoor, exposed supply ducts in Mechanical Room.
- B. Items Not Insulated:
  - 1. Factory-insulated flexible ducts.
  - 2. Factory-insulated plenums and casings.
  - 3. Flexible connectors.
  - 4. Vibration-control devices.
  - 5. Factory-insulated access panels and doors.
  - 6. Indoor, concealed return ducts.
  - 7. Indoor, concealed exhaust ducts.
  - 8. Exposed supply and return ducts within conditioned spaces.

### 3.13 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, supply-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- B. Outdoor-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
- C. Outdoor-air and Exhaust-air plenum insulation shall be the following:
  - 1. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.



- D. General Exhaust-air duct insulation within 10 ft of penetration of building exterior shall be the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
- E. Energy Recovery Unit Exhaust-air duct insulation between unit outlet and penetration of building exterior shall be the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
- F. Kitchen (Grease) Exhaust duct insulation shall be the following:
  - 1. Fire-Rated Blanket: Multiple layers as required by manufacturer for grease duct application to maintain zero clearance to combustibles.
- G. Indoor, exposed supply ducts in Mechanical Rooms duct insulation shall be the following: Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

### 3.14 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

### 3.15 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.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Underground piping.
  - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.16 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- B. Heating-Hot-Water Supply and Return, 200 Deg F and below:
  - 1. Piping Up to 4" NPS: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.
  - 2. Piping 4" and Larger: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.

- C. Refrigerant Suction and Hot-Gas Piping:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1 inch thick.

### 3.17 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1-1/2 inches thick.

### 3.18 FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Piping, Exposed: PVC: 20 mils thick.
  - 1. Kitchen and Food Service Areas.

END OF SECTION 230700

## SECTION 230800 - COMMISSIONING OF HVAC

## 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 commissioning process requirements for HVAC&R systems, assemblies, and equipment.
- B. Related Sections:
  - 1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

## 1.3 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

## 1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.
- C. Attend testing, adjusting, and balancing review and coordination meeting.
- D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

### 1.5 CxA'S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

### 1.6 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
  - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
  - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
  - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
  - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
  - 5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
  - 6. Test and inspection reports and certificates.
  - 7. Corrective action documents.
  - 8. Verification of testing, adjusting, and balancing reports.

### 1.7 SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, prestart, and startup activities.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 TESTING PREPARATION

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

### 3.2 TESTING AND BALANCING VERIFICATION

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
  - 1. The CxA will notify testing and balancing Subcontractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
  - 2. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
  - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
  - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

### 3.3 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the HVAC&R Subcontractor, testing and balancing Subcontractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### 3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in Division 23 boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.
- B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Assist the CxA with preparation of testing plans.
- C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC&R Subcontractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
  - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
  - 2. Description of equipment for flushing operations.
  - 3. Minimum flushing water velocity.
  - 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of oil, gas, hot-water, chilled-water, and solar systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- E. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- G. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 230800

## SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

## 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 control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Sections include the following:
  - 1. Division 1 Section 019113 "General Commissioning Requirements".
  - 2. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

## 1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. GUI: Graphical User Interface.
- C. I/O: Input/output.
- D. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- E. MS/TP: Master slave/token passing.
- F. PC: Personal computer.
- G. RTD: Resistance temperature detector.

## 1.4 SYSTEM DESCRIPTION

- A. The system shall be Direct Digital Control (DDC) with equipment furnished, installed and guaranteed by the Temperature Control Contractor.
- B. The Temperature Control Contractor shall provide a complete system of micro processor based direct digital automatic temperature control as herein specified, including all required micro processors, controllers, monitoring, I/O devices, software, sensors, transducers, wiring, thermostats, valves, relays, switches, etc. as indicated and required to achieve the Sequence of Operation and connection to devices specified and furnished with equipment under other Section. Work includes, but is not limited to, the following;

1. Thermostats and Sensors.
2. Control Valves and actuators.
3. Control Dampers and actuators.
4. Control Panels, Digital Control Cabinets.
5. Control Devices.
6. Wiring of Control Devices.
7. Sequence of Operation.

## 1.5 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
  2. DDC System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
  3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
  2. Wiring Diagrams: Power, signal, and control wiring.
  3. Details of control panel faces, including controls, instruments, and labeling.
  4. Written description of sequence of operation.
  5. Monitoring and Trend Logging system architecture.
  6. Schedule of dampers including size, leakage, and flow characteristics.
  7. Schedule of valves including flow characteristics.
  8. DDC System Hardware:
    - a. Wiring diagrams for control units with termination numbers.
    - b. Schematic diagrams and floor plans for field sensors and control hardware.
    - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
  9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, monitoring and trend logging, and operator notations.
- C. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Maintenance instructions and lists of spare parts for each type of control device.
  2. Interconnection wiring diagrams with identified and numbered system components and devices.
  3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
  4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
  5. Calibration records and list of set points.



## 1.6 QUALITY ASSURANCE

- A. **Installer Qualifications:** An experienced installer who is an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project. Control installation is not acceptable by wholesalers, contractors, and franchised dealers, or by any firm whose principal business is not direct manufacture and installation of automatic temperature control systems.
- B. **Manufacturer Qualifications:** A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
- 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 NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- E. Comply with ASHRAE 135-P for BACnet interoperability with all devices.
- F. Provide system compatible with existing facility managers control system. New control system shall utilize Ethernet Lan system for communication, supporting peer-to-peer networked communication, LonTalk communication protocol, connectivity at Lon, IP, and HMI levels.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. **Factory-Mounted Components:** Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. **System Software:** Update to latest version of software at Project completion.
- C. Store VFDs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFDs from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- D. If stored in areas subject to weather, cover VFCs to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

## 1.8 COORDINATION

- A. Coordinate location of thermostats, sensors, and other exposed controls with plans and room details before installation.
- B. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.
- C. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- D. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

## PART 2 - PRODUCTS

### 2.1 CONTROL SYSTEM

- A. Manufacturers:
  - 1. TAC/IA (Maine Controls).
  - 2. Honeywell.
  - 3. Johnson Controls, Inc.; Controls Group.
  - 4. Siemens Building Technologies, Inc.
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

## 2.2 DDC EQUIPMENT

- A. Operator Workstation:
  - 1. **PC:**
  - 2. **Printer:**
  - 3. Application Software:
    - a. I/O capability from operator station.
    - b. System security for each operator via software password and access levels.
    - c. Automatic system diagnostics; monitor system and report failures.
    - d. Database creation and support.
    - e. Automatic and manual database save and restore.
    - f. Dynamic color graphic displays with up to 10 screen displays at once.
    - g. Custom graphics generation and graphics library of HVAC equipment and symbols.
    - h. Alarm processing, messages, and reactions.
    - i. Trend logs retrievable in spreadsheets and database programs.
    - j. Alarm and event processing.
    - k. Object and property status and control.
    - l. Automatic restart of field equipment on restoration of power.
    - m. Data collection, reports, and logs. Include standard reports for the following:
      - 1) Current values of all objects.
      - 2) Current alarm summary.
      - 3) Disabled objects.
      - 4) Alarm lockout objects.
      - 5) Logs.
    - n. Custom report development.
    - o. Utility and weather reports.
    - p. Workstation application editors for controllers and schedules.
    - q. Maintenance management.
  - 4. Custom Application Software:
    - a. English language oriented.

- b. Full-screen character editor/programming environment.
  - c. Allow development of independently executing program modules with debugging/simulation capability.
  - d. Support conditional statements.
  - e. Support floating-point arithmetic with mathematic functions.
  - f. Contains predefined time variables.
- B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
  2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse I/O.
    - c. Monitoring, controlling, or addressing data points.
    - d. Software applications, scheduling, and alarm processing.
    - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
  3. Standard Application Programs:
    - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
    - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
    - c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
    - d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
    - e. Remote communications.
    - f. Maintenance management.
    - g. Units of Measure: Inch-pound and SI (metric).
  4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
  5. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.
- C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
  2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse I/O.
    - c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
4. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.

D. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

### 2.3 DIGITAL CONTROLLERS (D.C.C.)

A. Main Components and Features:

1. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system. The FMCS requires the incorporation of LonWorks Technologies using Free Topology Transceivers (FTT-10), and specific conformance to the LONMARK Interoperability Association's v3.0 Physical and logical Layer guidelines in all unitary, terminal unit and other devices.
2. LonTalk communications protocol will be used on the communication network between FMCS controllers and other LonWorks devices to assure interoperability between all devices within the network.
3. The FMCS shall support the direct integration of standard and non-standard communicating systems. At a minimum, the FMCS shall deliver connectivity at the Lon, IP, and HMI levels through standard offerings. The FMCS shall offer as a standard available solution, a minimum of 300 individual communicating interfaces to 3rd party products.
4. The FMCS shall provide a standard available test kit for development of additional interfaces by others, in addition to the FMCS manufacturer.
5. The FMCS shall provide compliance with the ASHRAE standard 135-P for BACnet interoperability with all devices within the FMCS.
6. The FMCS shall provide a high speed Network Interface that shall plug directly into the controller node which supports one of the following types of communication standards between controller nodes:
  - a. Ethernet: The intent for this project is to utilize the facility Ethernet Lan as the FMCS communications backbone between the area controllers and the thin clients.

The Network Interface shall employ Carrier Sense Multiple Access/Collision Detect (CSMA/CD) contention type protocol, which adheres to the industry standard format IEEE 802.3. The content of messages shall be the manufacturer's standard. The Network Interface shall be fully Internet Protocol (IP) compliant allowing connection to currently installed IEEE 802.3 compliant Ethernet Networks.

The Network Interface shall directly support connectivity to a variety of cabling types. As a minimum provide the following connectivity: 10Base2 (ThinNet RG-58 A/U Coaxial cabling with BNC connectors), 10BaseT (Twisted-Pair RJ-45 terminated UTP cabling).

- b. Echelon: The FMCS shall employ LonTalk communications utilizing the LonWorks Neuron chip on the device bus, which conforms to the International Standards Organization's (ISO) seven layer Open Systems Interconnect (OSI) network protocol model. The content of messages shall be the manufacturer's standard. The Neuron chip and

a transformer-isolated transceiver shall provide for 78.8kbps communications over Category 4 Unshielded Twisted Pair (UTP) cabling.

To facilitate facility expansion or to support large Wide Area Networks (WANs) the Network Interface shall directly support a minimum of 4 logical networks using the same physical network (Ethernet or Echelon). Each logical network shall support a minimum of 126 controller nodes.

The ability to support bi-directional access to remote controller nodes shall be supported by a single point of connection. The ability to monitor and edit system data shall be provided via the controller node remote communications connection. Connection via the HMI, the GP as well as a standard VT-100 terminal interface shall be provided. Support for solicited as well as unsolicited communications is a requirement.

- c. Other Requirements: Each stand-alone digital control cabinet shall be programmable through the hand held operator terminal or C.P.I. terminal. Software architecture shall allow both standard setups of point types, EMS Programs, loops of related parameters as well as custom program linking with math and logic. In addition, the network shall allow the building operations a means of interrogating input/output sensor conditions, such as interrogating the values of analog sensor input upon request, or the status of control via the standard keyboard and display unit, or the P.C.I. terminal unit.

All programming shall allow a minimum of three levels of entry with code requirements; level one for general data entry; level two for overall system entry; level three for programming.

B. DDC Sensor (for all DDC controllers)

1. The DDC Sensor shall connect directly to the DDC Controller and shall not utilize any of the I/O points of the controller. The DDC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive. The DDC Sensor shall provide a communications jack for connection to the LON communication trunk to which the DDC controller is connected. The DDC Sensor, the connected controller, and all other devices on the LON bus shall be accessible by the Graphical Programming tool.
  - a. The DDC Sensor shall be supplied in the following variations;
    - 1) Tamper-resistant (no display)
    - 2) Tamper-resistant with tenant override
    - 3) Basic user functions (LCD display and setpoint adjustment and tenant override)
    - 4) Full user functions (LCD display and network-variable access and tenant override)
    - 5) ASHRAE 95 compliance (LCD display and sub-base functionality)
2. The DDC Sensor shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of the electronics or esthetic covering. The DDC Sensor shall allow for the customization of the color on the esthetic covering as a standard offering. User interface with the DDC Sensor shall be provided as a configurable function by the FMCS, and shall offer password protection for access to network variable editing. Multiple network variables shall be accessible and editable by the DDC Sensor. Icons shall be utilized to represent sensor and controller function status, affording independence from a single language for use interface.

C. INTEROPERABLE LONMARK CONTROLLERS (ILC)

1. Controls shall be microprocessor based Interoperable LONMARK Controllers (ILC), bearing the applicable LONMARK interoperability logo on each product delivered. ILCs shall be provided for Unit Ventilators, Fan Coils, Heat Pumps, VAV Terminal Boxes and other applications as shown on the drawings. ILCs shall be based on the Echelon Neuron 3150 microprocessor working from software program memory which is physically located in the ILC. The application control

- program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals.
2. To simplify controls and mechanical service troubleshooting, the ILC shall be mounted directly in the control compartment of the unitary system. The ILC shall be provided with a sheet metal or polymeric enclosure that is constructed of material allowing for the direct mounting within the primary air stream, as defined by UL-465. The direct mounting shall allow all controls maintenance and troubleshooting to be made while at the unitary equipment.
  3. The ILCs shall communicate with the GUI at a baud rate of not less than 78.8K baud. The ILC shall provide LED indication of communication and controller performance to the technician, without cover removal.
  4. The ILCs shall be fully supported and communicate with any and all GUI(s) on the bus.
  5. The ILC shall provide a -40 to 140 degree Fahrenheit ambient operating temperature range. The ILC shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of any of the ILC electronics. ILC devices that require the electronics to be present at the time of wiring, will require an additional controller to be provided for every 10 devices on the drawings, to allow for the preconfiguration and storing for service purposes.
  6. All input/output signals shall be directly hardwired to the ILC. For all non-VAV terminal applications, a minimum of two input points of the ILC shall employ a universal configuration that allows for flexibility in application ranging from dry contact, resistive, to voltage/current sourced inputs. If universal points are not available, a minimum of two input points (each) of the dry contact, resistive and analog voltage/current types must be provided on every controller. The outputs of the ILC shall be of the relay and universal analog form. All digital outputs shall be relay type. ILC devices utilizing non-relay outputs shall provide an interface relay for all points. All analog outputs shall be programmable for their start points and span to accommodate the control devices. Configuration of all I/O points shall be accomplished without physical hardware jumpers, switches or settings. Troubleshooting of input/output signals shall be easily executed with the Graphical Programming tool (GP) or a volt-ohm meter (VOM). All I/O points shall be utilized by the local ILC or shall be available as I/O points for other controllers throughout the network.
  7. All ILCs shall be fully application programmable and shall at all times maintain their LONMARK certification. All control sequences within or programmed into the ILC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
  8. The ILC shall be provided with the ability to interface with the Graphical Programming tool. The interface port shall be provided at the wall sensor or within the unitary equipment, as specified on the plans. The interface port shall allow the GP to have full functionality as described in GP section of this specification. Through the connected controller all ILC devices on the LON bus shall be accessible by the Graphical Programming tool.
  9. Mechanical equipment manufacturers desiring to provide ILC type controls as factory mounted equipment shall provide a separate bid for their products less all controls, actuators, valve assemblies and sensors, which are specified to be provided by the FMCS contractor.

#### D. INTEROPERABLE DIGITAL CONTROLLERS (IDC)

1. Controls shall be microprocessor based Interoperable LonWorks Digital Controllers (IDC), providing interoperability with all LONMARK and LonWorks devices. IDCs shall be provided for any equipment applications as required, as shown on the drawings. IDCs shall be based on the Echelon Neuron Hosted microprocessor architecture, working from software program memory that is physically located in the IDC. The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals.
2. All IDCs shall be fully application programmable utilizing graphical objects. All control sequences programmed into the IDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. Systems that only allow selection of sequences from a library or table are not acceptable.
3. The IDC shall be provided with the ability to interface with the Graphical Programming tool. The interface port shall allow the GP to have full functionality as described in GP section of this

specification. Through the interface port all IDC devices on the LON bus shall be accessible by the Graphical Programming tool.

4. The IDCs shall communicate with the SDC at a baud rate of not less than 78.8K baud. The IDC shall have as a minimum ambient operating temperature range of 32 to 122 degrees Fahrenheit.
5. The IDC shall be fully supported by the Graphical User Interface (GUI).
6. All input/output signals shall be directly hardwired to the IDC. All controllers shall employ a universal input configuration that allows for flexibility in application ranging from dry contact, resistive, to voltage/current-sourced inputs. If universal points are not available, a minimum of one spare input point (each) of the dry contact, resistive and analog voltage/current types must be provided for each input point utilized. IDC devices shall provide digital and analog output types and quantities consistent with the requirements of the application requirements. Troubleshooting of input/output signals shall be easily executed with the Graphical Programming tool or a volt-ohm meter (VOM). All I/O points shall be utilized by the local ILC or shall be available as I/O points for other controllers throughout the network.
7. To simplify controls and mechanical service troubleshooting, the IDC shall be mounted directly in or on the control compartment of the air handling system. The IDC shall be provided in a NEMA 1 enclosure to accommodate direct mounting on the equipment to be controlled. The IDC shall be constructed in a modular orientation such that service of the failed components can be done quickly and easily. The modular construction should limit the quantities of printed circuit boards to a maximum of two. All logic, control system, power supply and input/output circuitry shall be contained on a single plug-in circuit board. All wiring terminations shall be made to serviceable connections allowing controller reconfiguration without the removal of any terminated wires. This shall allow all controls maintenance and troubleshooting to be made while at the air handling unit. The IDC shall be directly wired to sensory devices, staging relays or modulating valves for heating and cooling.
8. The FMCS contractor shall provide and field install all IDCs specified under this section. Mechanical equipment manufacturers desiring to provide IDC type controls as factory mounted equipment shall provide a separate bid for their products less all controls, actuators, valve assemblies and sensors, which are specified to be provided by the BAS/Temperature control contractor.

## 2.4 GRAPHICAL USER INTERFACE SOFTWARE

### A. OPEN ARCHITECTURE, BROWSER BASED GUI

1. A graphical user interface shall be included with the host computer system software. This user interface shall allow, with proper password access, full interaction with the system including, but not limited to, viewing and modifying data, database administration, configuration of communications parameters, password and security administration, programming and configuration of objects, receipt, routing and acknowledgement of alarms, and development of graphic screens.
2. The user interface shall employ browser-like functionality for ease of navigation. It shall include a tree view for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation techniques similar to those in a commercially available Web Browser. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.
3. Graphic screens shall be developed using any drawing package capable of generating a .GIF, .BMP, or .JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of, a graphic background, the user interface shall support the use of scanned pictures.
4. Graphics developed for the user interface shall be capable of being used by a standard Web Browser client, without the need to develop additional graphic screens specifically for the Web Browser. Graphics used by the Web Browser client(s) shall be capable of being edited using a standard HTML document editor.

5. Graphic screens shall have the capability to be overlaid with text, real-time values, command and adjust, animation, color spectrum, logs, graphs, HTML document links, and schedule graphic objects, as well as links to other graphic screens.
6. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
7. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
8. Holidays shall be set by using a graphical calendar without requiring any keyboard entry from the operator.
9. Commands issued to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
10. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.
11. The graphic screens shall be three dimensional and contain all of the points associated with the equipment being controlled. Provide the ability to change set point and monitor equipment running status. Provide a sample of graphic screens to the engineer for his review before final design of the graphic screens. Modify the graphic screen, if required by the engineer, shall be done at no cost. Text screens are NOT acceptable.
12. ALL graphic screens and system programming MUST be done in the local Office, by the certified programming specialist for the system provided.
13. Graphic screens shall be provided for the following:
  - a. All HVAC equipment.
  - b. Floor plans per floor showing equipment and points per floor.
  - c. Schedule screen.

#### B. ALARM CONSOLE

1. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm.
2. A separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

#### C. WEB BROWSER CLIENTS

1. The system shall be capable of supporting an unlimited number of clients using a standard Web Browser such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software resident on the client machine or manufacture-specific browsers shall not be acceptable.
2. The Web Browser client shall support at a minimum, the following functions:
  - a. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication techniques to prevent unauthorized access shall be implemented.
  - b. Graphical screens developed for the GUI shall be the same screens used for the Web Browser client. Storage of the graphical screens shall be in the system, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
  - c. Depending on user access privileges, the user shall be able to view data, modify and command objects such as start/stop, and adjust set points. In addition, users can be provided with the ability to view logs and view and acknowledge alarms.



3. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. The capability to limit the user to just their home page shall be provided. From the home page, links to other views, or pages in the system shall be possible.
4. Graphic screens on the Web Browser client shall support hypertext links to other Web pages on other Internet or Intranet sites.

#### D. OBJECT LIBRARIES

1. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
2. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.
3. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.
4. The library shall include applications or objects for the following functions:
  - a. Scheduling Object. Provide a BACnet compliant, 7-day plus holiday & temporary scheduling object to allow for a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.
  - b. Calendar Object. Provide a BACnet compliant 12-month calendar object to allow for holiday or special event data entry. Data entry to be by graphical "point-and-click" selection. This object must be "linkable" to any or all scheduling-objects for effective event control.
  - c. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals.
  - d. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.
  - e. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.
  - f. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the

reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

5. At a minimum, the library shall include services to support LonWorks and BACnet networks.
  - a. The library shall include control objects for the following functions at a minimum:
  - b. Analog Input Object - Minimum requirement is to meet the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
  - c. Analog Output Object - Minimum requirement is to meet the BACnet standard for data sharing.
  - d. Binary Input Object - Minimum requirement is to meet the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.
  - e. Binary Output Object - Minimum requirement is to meet the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme must also be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing this contention resolution shall not be acceptable.
  - f. PID Control Loop Object - Minimum requirement is to meet the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.
  - g. Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.
  - h. Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.
  - i. Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.
  - j. Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.
  - k. Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an "On" state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be

enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.

1. Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the “contained” application that are represented on the graphical shell of this container.
6. The object library shall include objects to support common LonMark devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering.

## 2.5 MONITORING AND TREND LOGGING

- A. Provide hardware, software and programming for monitoring and trend logging of mechanical and electrical systems, necessary for facility operators and commissioning entities to easily diagnose problems and verify that systems are operating according to design intent.
  1. Sensor to monitor and trend (create trend logs) at the operator interface controlled variables (i.e. air flow, water flow, temperature, pressure, CO<sub>2</sub>, pump speed, and fan speed).
  2. Sensors to trend outdoor air temperatures.
  3. Sensors to monitor and trend equipment status for all equipment with motors greater than ½ HP.
  4. Indication and trending of damper and valve command position.
  5. Sensors to monitor building electrical and fuel oil demand and consumption.
  6. Sensors to monitor indoor and outdoor CO<sub>2</sub>.
- B. Provide point’s matrix including all hardwired input and output devices connected to the automation system, all set points, upper and lower control limits.
- C. Trend requirements to include a trend point list and a preprogrammed sample of points, sample rate, storage interval, upload interval, custom trend capabilities, alarms, and automated trend data review and notification.
- D. System architecture shall be capable of allowing sampling of these points to facilitate building commissioning and diagnostics without significantly affecting system performance.
- E. Data storage system shall be provided with adequate capacity to record trend data for use by building operators. Data export requirements must facilitate user-friendly data access and manipulation.
- F. Operator interface shall be designed for remote /web access, monitoring requirements, trend –log reporting, and diagnosing building problems through a user-friendly interface. Provide visual (non-text based) operations and reporting interface to facilitate rapid system assessment that utilizes color coding, diagrams of floor plans and graphing capabilities.

## 2.6 CONTROL PANELS

- A. Wherever three or more manual switches, relays, controllers, or other control devices (not including room thermostats or duct-mounted instruments) are required for a ventilating unit or system, such devices shall be grouped and mounted in a control panel. Panels shall be made of enameled steel. Panels shall be secured to walls or unit casings with sufficient space in the rear for access to wiring, etc.

## 2.7 DIRECT DIGITAL CONTROL (D.D.C.) OF OPERATORS

- A. General: Direct control capability using a custom control program, manual command, or time program initiated commands shall be provided as a standard features of this system. It shall be possible to input a sensor or group of sensors to the D.C.C. unit, process the data using the features of a Custom Control Program, and output an analog control signal or setpoint directly to a controlled valve or damper. It shall not be necessary to provide intermediate controllers to condition the signal for the valve or damper actuator. The output signal shall be scaled in software to be compatible with industry standard control signal variables, such as three (3) to six (6) volts, six (6) to nine (9) volts.
- B. Main Components and Features:
1. Motors: For each automatically-controlled damper or valve, a suitable damper motor or motors shall be provided in accordance with the following specifications:
    - a. Operator: Motors shall be of the fully proportioning type, non-hydraulic. The motor shall have a rating of not less than twice the thrust needed for actual operation of the damper of valve.
    - b. Adjustments: Motor shall have adjustable stops to adjust the open and closed positions and adjustable return spring on damper motor.
    - c. Mounting: Damper motor shall be provided with suitable mounting base and frame. The damper motor and mounting base shall not be mounted directly on cold or insulated ducts and casings, but shall be mounted outside the insulated covering in such a manner as to prevent sweating and interference with the insulation.
  2. Sensors: Linear precision resistance elements and resistance averaging elements shall be provided for temperature sensing. Their range shall be -50 to 250 degrees Fahrenheit with an accuracy of +/- 0.5 degrees Fahrenheit.

## 2.8 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
1. Accuracy: Plus or minus 0.5 deg F at calibration point.
  2. Wire: Twisted, shielded-pair cable.
  3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
  4. Averaging Elements in Ducts: 18 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
  5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
  6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
  7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
- C. Equipment operation sensors as follows:
1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 inches wg.
  2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig.
  3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
- D. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

- E. Water-Flow Switches: Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle. For chilled-water applications, provide vaporproof type.
- F. Humidistats: Humidity Sensors: Bulk polymer sensor element.
  - 1. Accuracy: 5 percent full range with linear output.
  - 2. Room Sensor Range: 20 to 80 percent relative humidity.
- G. Occupancy Sensors: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment, for flush mounting.
- H. CO2 Sensors: Carbon-Dioxide Sensor and Transmitter: Single detectors, using solid-state infrared sensors, suitable over a temperature range of 23 to 130 deg F, calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted.
- I. Room sensor accessories include the following:
  - 1. Provide guards for Gym area.

## 2.9 THERMOSTATS

- A. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- B. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type, with adjustable set point in middle of range and adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- C. Electric Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
  - 1. Bulb Length: Minimum 20 feet.
  - 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- D. Electric High-Limit Duct Sensor/Discharge Sensor.
- E. DDC Thermostat with LED readout, set-point, and manual override equal to S-Link type by Invensys.

## 2.10 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
  - 1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
  - 3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
  - 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.

5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
2. Dampers: Size for running torque calculated as follows:
  - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
  - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
  - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
  - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
  - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
  - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
3. Coupling: V-bolt and V-shaped, toothed cradle.
4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
6. Power Requirements (Two-Position Spring Return): 24-V ac.
7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
9. Temperature Rating: Minus 22 to plus 122 deg F.
10. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
11. Run Time: 30 seconds.

## 2.11 CONTROL VALVES

- A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Globe Valves NPS 2 and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
- C. Globe Valves NPS 2-1/2 and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
- D. Hydronic system globe valves shall have the following characteristics:
  1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
  2. Internal Construction: Replaceable plugs and seats of stainless steel or brass.
  3. Sizing: 3-psig maximum pressure drop at design flow rate.
  4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.
- E. Terminal Unit Control Valves: Bronze body, bronze trim, two- or three-port as indicated, replaceable plugs and seats, union and threaded ends.
  1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.

2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

## 2.12 DAMPERS

- A. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze or nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
  2. Operating Temperature Range: From minus 40 to plus 200 deg F.
  3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
  4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

## 2.13 VARIABLE FREQUENCY CONTROLLERS (VFDs)

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following;
1. Cerrus Industrial.
  2. Eaton Corp.: Cutler-Hammer Products.
  3. Emerson Industrial Automation.
  4. General Electric Distribution & Control.
  5. Yaskawa Electric America, Inc. (MagneTek Drives and Systems).
  6. Square D Co.
- B. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, premium-efficiency induction motor by adjusting output voltage and frequency. Units shall be provided with main power disconnect.
- C. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- D. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.
- E. Unit Operating Requirements:
1. Input ac voltage tolerance of 380 to 500 V, plus or minus 10 percent.
  2. Input frequency tolerance of 50/60 Hz, plus or minus 5 percent.
  3. Capable of driving full load, under the following conditions, without derating:
    - a. Ambient Temperature: Minus 10 to 40 deg C.
    - b. Humidity: Less than 95 percent (non-condensing).
    - c. Altitude: 3300 feet.

4. Minimum Efficiency: 96 percent at 60 Hz, full load.
  5. Minimum Displacement Primary-Side Power Factor: 98 percent.
  6. Overload Capability: 1.5 times the base load current for 60 seconds.
  7. Starting Torque: 150 percent of rated torque or as indicated.
  8. Speed Regulation: Plus or minus 1 percent.
  9. Isolated control interface to allow controller to follow control signal over an 40:1 speed range.
- F. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
  2. Maximum Speed: 80 to 100 percent of maximum rpm.
  3. Acceleration: 2 to a minimum of 1 second.
  4. Deceleration: 2 to a minimum of 1 second.
  5. Current Limit: 50 to a minimum of 110 percent of maximum rating.
- G. Self-Protection and Reliability Features:
1. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
  2. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 20 performance.
  3. Instantaneous line-to-line and line-to-ground overcurrent trips.
  4. Reverse-phase protection.
  5. Short-circuit protection.
  6. Motor overtemperature fault.
- H. Automatic Reset and Restart: To attempt ten restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
- I. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.
- J. Torque Boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.
- K. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.
- L. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
1. Power on.
  2. Line fault.
- M. Alphanumeric Display: Liquid-crystal type, 16 characters, minimum.
- N. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.
- O. Indicating Devices: Digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
1. Output frequency (Hz).
  2. Motor speed (rpm).
  3. Motor status (running, stop, fault).
  4. Motor current (amperes).



5. Motor torque (percent).
  6. Fault or alarming status (code).
  7. PID feedback signal (percent).
  8. DC-link voltage (VDC).
  9. Set-point frequency (Hz).
  10. Motor output voltage (V).
- P. Control Signal Interface: Provide from VFC Lon interface communications module, with the following:
1. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from other control systems:
    - a. 0 to 10-V dc.
    - b. 4 to 20 mA.
    - c. Keypad display for local hand operation.
  2. Output Signal Interface:
    - a. A minimum of 1 analog output signal (4-20 mA), which can be programmed to either of the following:
      - 1) DC-link voltage (VDC).
      - 2) Set-point frequency (Hz).
  3. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
    - a. Motor running.
    - b. Set-point speed reached.
    - c. Fault and warning indication (overtemperature or overcurrent).
    - d. PID high or low speed limits reached.
- Q. Communications: Provide an LON communications card allowing VFC to be used with an external system within a multidrop LAN configuration. Provide capability for VFC to retain these settings within the nonvolatile memory. LON communications module connected directly with LON communications bus for information and programming.
- R. Accessories
1. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
  2. Control Relays: Auxiliary and adjustable time-delay relays.
  3. Standard Displays:
    - a. Output frequency (Hz).
    - b. Set-point frequency (Hz).
  4. Motor current (amperes).
    - a. Motor full-load current (amperes).
    - b. DC-link voltage (VDC).
    - c. Motor torque (percent).
    - d. Motor speed (rpm).
    - e. Motor output voltage (V).
    - f. Motor output power (kW).
    - g. Status: Forward or reverse.
  5. Historical Logging Information and Displays:
  6. Total run time.
  7. Fault log, maintaining last four faults.

**2.14 UPS**

## 2.15 CONTROL CABLE

- A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Verify that power supply is available to control units and operator workstation.

## 3.2 INSTALLATION

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
  - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Install automatic dampers according to Division 23 Section "Air Duct Accessories."
- E. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- F. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- G. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- H. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

## 3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
  - 1. Communication wiring shall be Lon compliant Category 4 or 5 twisted unshielded pair.

2. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
  3. Install exposed cable in raceway.
  4. Install concealed cable shall be run together and supported every 4-feet. All wiring shall be at right angles to building structure.
  5. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
  6. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
  7. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
  8. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

### 3.4 ADJUSTING

- A. Calibrating and Adjusting:
1. Calibrate instruments.
  2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
  3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
  4. Control System Inputs and Outputs:
    - a. Check analog inputs at 0, 50, and 100 percent of span.
    - b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    - c. Check digital inputs using jumper wire.
    - d. Check digital outputs using ohmmeter to test for contact making or breaking.
    - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
  5. Flow:
    - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
    - b. Manually operate flow switches to verify that they make or break contact.
  6. Pressure:
    - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
    - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
  7. Temperature:
    - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
    - b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

### 3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 230900

## SECTION 230993 - SEQUENCE OF OPERATION FOR HVAC CONTROLS

## 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 control sequences for HVAC systems, subsystems, and equipment.
- B. Related Sections include the following:
  - 1. Division 1 Section 019113 "General Commissioning Requirements".
  - 2. Division 22 Section "Domestic Water Heat Exchangers" for controls components furnished with equipment.
  - 3. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.
  - 4. Division 23 Section "Firetube Boilers" for controls components furnished with equipment.
  - 5. Division 23 Section "Modular Air Handling Units" for controls components furnished with equipment.
  - 6. Division 23 Section "Outdoor, Direct Gas Fired Heating and Ventilating Units" for controls components furnished with equipment.
  - 7. Division 23 Section "Commercial Kitchen Hoods" for controls components furnished with equipment.
  - 8. Division 23 Section "Scroll Water Chillers" for controls components furnished with equipment.

## 1.3 DEFINITIONS

- A. DDC: Direct digital control.

## 1.4 HEATING SYSTEM CONTROL SEQUENCES

- A. Hot Water Boilers:
  - 1. Refer to Division 23 Section "Firetube Boilers" for controls components furnished with equipment. Coordinate and integrate with building controls system.
    - a. Boilers specified to be furnished with factory installed and programmed controller consisting of components to include operation of the following:

- 1) Two fully modulating boilers.
- 2) Boiler water primary circulating pumps (P-1, P-2).
- 3) Boiler water supply temperature, flow control valves, and thermal shock protection.
- 4) Combustion air damper and mechanical combustion air supply VFD.
- 5) Relief air damper.

b. Third party external control is not required to operate and sequence the boilers to meet facility demand.

B. Secondary Heating Pump Control: (P-3, P-4)

1. Pump shall be energized to operate continuously when outdoor air temperature is below 65 deg F (adjustable).
2. Pumps shall have VFD's. Provide a differential pressure sensor to control the system pressure by modulating the respective pump. Locate sensor pipe mounted at approximately 2/3 point in piping distribution. Provide on / off and lead / lag and rotation of pumps. Provide a current sensor for each pump to monitor and report status. If either pump fails then the other pump shall start and signal alarm to the DDC System. Provide a dead band in the programming to prevent short cycling. The respective pumps shall rotate on a monthly basis.

C. Indirect Fired Domestic Hot Water Zone Pump Control (P-5):

1. Packaged Domestic Water Heat Exchangers specified furnished with factory piped and wired control valve and integral electronic controls to modulate control valve and cycle associated constant volume boiler water pump to maintain domestic hot water storage tank(s) temperature set point during occupied modes. Disable associated boiler water pumps during unoccupied modes.

D. Control points to be provided and shown on the graphic page are as follows:

1. DDC system graphic.
2. On /off status for each boiler.
3. Outside air temperature.
4. Outside air humidity.
5. Hot water supply schedule.
6. Hot water supply temperature.
7. Hot water return temperature.
8. Hot water supply schedule.
9. Reset 3-way valve signal and position.
10. On / off status for each pump.
11. VFD frequency and percent for each pump.
12. Differential pressure (setpoint) for each heating system.
13. Differential pressure (measured) for each heating system.
14. Lead/Lag and rotation schedule.

## 1.5 BOILER ROOM VENTILATION SEQUENCES

- A. Boiler Combustion-Air Control: Mechanical Combustion Air Supply Fan system shall modulate to maintain boiler room pressure. On signal from either boiler burner, combustion air intake louver shall open and associated damper end switch shall energize fan.
- B. Boiler Room Ventilation Air Relief Control: Open damper when space temperature rises above space thermostat set point; close damper when space temperature falls below thermostat set point.

## 1.6 CHILLED WATER SYSTEM CONTROL SEQUENCE:

- A. Packaged Chiller specified with factory furnished and installed control package. Refer to Specification Sections 236423 "Scroll Water Chillers". Coordinate and integrate with building controls system.
- B. Chilled-Water Circulating Pump Control: Interlock with chiller. System starts pump and proves flow through chiller before allowing chiller to start.
- C. Chilled-Water Supply Temperature Control: System maintains constant leaving chilled-water temperature set-point during occupied periods. System resets chilled-water supply temperature according to highest cooling demand during occupied and unoccupied periods.
- D. Operator Workstation: Display the following data:
  - 1. Outside temperature.
  - 2. Chiller on-off status.
  - 3. Entering chilled-water temperature.
  - 4. Entering chilled-water temperature set point.
  - 5. Leaving chilled-water temperature.
  - 6. Operating status of primary chilled-water pump.
  - 7. Common trouble alarm from Packaged Chiller factory furnished and installed control package.

## 1.7 DEDICATED OUTDOOR AIR - VAV H&amp;V AIR HANDLING UNIT CONTROL SEQUENCE (AHU-3 SERVING CLASSROOMS)

- A. Air handling system shall start through DDC system provided all safeties have been satisfied.
- B. Fan Control: System commands supply and exhaust fans to run continuously when building is occupied. The respective VFD's on the supply and exhaust fans shall provide for a soft start and ramp to maintain supply air duct static pressure setpoints (adjustable). Supply and exhaust duct static pressure sensors shall be located in the associated duct system at 2/3 of the furthest run. A CO2 sensor in the return air duct shall increase the fan speed based on elevated CO2 levels in the common return duct
- C. Outdoor Airflow Monitoring: Air handling units scheduled and specified furnished with factory installed airflow outdoor airflow measuring stations. System shall continually monitor outdoor airflow and signal alarm to the DDC system if less than scheduled minimum.
- D. Stop Mode: The supply fan and exhaust fans will be off, the outside air damper will be closed, and the heating valve will be full open.
- E. Smoke detection: Stop fans, and return system to STOP mode upon a signal from the fire alarm system. Wiring from the fire alarm device to the motor starters provided under Division 26.
- F. Supply Air Temperature Control: During occupied periods system modulates total energy wheel control and heating control valve to maintain supply air temperature occupied set-point, (2 deg F below room setpoint). AHU specified with factory installed variable speed wheel controls, (refer to Section 237313). During morning warm up supply air temperature shall be increased to achieve room setpoint. During unoccupied periods, cycle heating valve to maintain unoccupied set-point.
- G. Freeze Protection: Provide a manual reset freeze stat across the heating coil to stop the fan, close the outside air damper, fully open heating control valve, and alarm the DDC system if the freeze stat trips.
- H. Control points to be provided and shown on the graphic page are as follows:
  - 1. DDC system graphic.
  - 2. DDC system on-off indication.

3. DDC system occupied/unoccupied mode.
4. Damper position of each damper.
5. Outdoor airflow setpoint, minimum, and actual measured, CFM.
6. Outdoor-air-temperature indication.
7. Exhaust air-temperature indication.
8. Supply-air-temperature indication.
9. Supply-air-temperature setpoint.
10. Return air-temperature indication.
11. Heating-coil control-valve position.
12. Smoke detection alarm.
13. Fan Status.
14. Fan Speed.
15. VFD frequency and % speed.
16. Freeze Protection Alarm.
17. CO2 Level.

1.7 MIXED AIR – VAV H&V AIR HANDLING UNIT CONTROL SEQUENCE  
(AHU-1 GYM; AHU-2 CAFE)

- A. Air handling system shall start through DDC system provided all safeties have been satisfied.
- B. Occupied: The Air Handler supply and return fans shall be enabled during occupied mode, but only run when either of the motion sensors sense movement. A space sensor shall maintain occupied set point when the fan is in the occupied mode and motion is detected by modulating the economizer dampers and the heating valve in sequence to maintain space temperature.
- C. Fan Control: When the fan starts during the occupied mode the outside air, return air, and exhaust air dampers shall open to their minimum. The respective VFD's on the supply and return fans shall provide for a soft start and ramp to provide and maintain the scheduled minimum outdoor airflow. A CO2 sensor in the return air duct shall increase the fan speeds and also control the outside air, return air, and relief air based on CO2 levels in the common return duct.
- D. Outdoor Airflow Monitoring: Air handling units scheduled and specified furnished with factory installed airflow outdoor airflow measuring stations. System shall continually monitor outdoor airflow and signal alarm to the DDC system if less than scheduled minimum.
- E. Stop Mode: The supply fan and return fans will be off, the outside air damper will be closed, and the heating valve will be full open.
- F. Smoke detection: Stop fans, and return system to STOP mode upon a signal from the fire alarm system. Wiring from the fire alarm device to the motor starters provided under Division 26. Provide status of each fan and alarm the DDC system if a fan fails to start.
- G. Freeze Protection: Provide a manual reset freeze stat across the heating coil to stop the fan, close the outside air damper, fully open heating control valve, and alarm the DDC system if the freeze stat trips.
- H. Hydronic Heating Coil: During occupied periods system modulates control valve to maintain supply air temperature occupied set-point. During unoccupied periods, cycle valve to maintain unoccupied set-point. A discharge air sensor shall provide a discharge air low limit by modulating the heating valve to prevent the discharge air from falling below set point. A mixed air sensor located in the mixing box, averaging type, shall monitor the mixed air temperature. Provide mixed air reset.
- I. Unoccupied: The Air Handler supply and return fans shall remain off. The outside air, return air, and relief air dampers shall be in their normal state. The space sensor shall cycle the fans, at minimal speed, and



heating valve to maintain night set back temperature. A push button override on the space sensor shall allow the Air Handler to operate in the occupied mode for a predetermine time.

J. Control points to be provided and shown on the graphic page are as follows:

1. DDC system graphic.
2. DDC system on-off indication.
3. DDC system occupied/unoccupied mode.
4. Damper position of each damper.
5. Outdoor airflow setpoint, minimum, and actual measured, CFM.
6. Outdoor-air-temperature indication.
7. Exhaust air-temperature indication.
8. Supply-air-temperature indication.
9. Supply-air-temperature setpoint.
10. Return air-temperature indication.
11. Heating-coil control-valve position.
12. Smoke detection alarm.
13. Fan Status.
14. Fan Speed.
15. VFD frequency and % speed.
16. Mixed Air Temperature.
17. Mixed Air Temperature Set Point.
18. Freeze Protection Alarm.
19. CO2 Level.
20. Space Temperature Set Point.
21. Space Temperature.

#### 1.9 MIXED AIR – VAV HVAC AIR HANDLING UNIT CONTROL SEQUENCE (AHU-4 ADMIN/OFFICE AREA)

- A. Air handling system shall start through DDC system provided all safeties have been satisfied.
- B. Occupied: The supply and return fans shall be enabled during occupied mode. A space sensor shall maintain occupied supply air set point when the fan is in the occupied mode by modulating the economizer dampers and the heating valve, cooling valve, in sequence to maintain space temperature setpoint.
- C. Fan Control: When the fan starts during the occupied mode the outside air, return air, return air dampers shall open to their minimum. The respective VFD's on the supply and return fans shall provide for a soft start and ramp to maintain supply air duct static pressure setpoints (adjustable). Supply and exhaust duct static pressure sensors shall be located in the associated duct system at 2/3 of the furthest run. A CO2 sensor in the return air duct shall increase the fan speeds and also control the outside air, return air, and relief air based on CO2 levels in the common return duct.
- D. Outdoor Airflow Monitoring: Air handling units scheduled and specified furnished with factory installed airflow outdoor airflow measuring stations. System shall continually measure outdoor airflow and signal alarm to the DDC system if less than scheduled minimum.
- E. Stop Mode: The supply fan and return fans will be off, the outside air damper will be closed, and the heating valve will be full open.
- F. Smoke detection: Stop fans, and return system to STOP mode upon a signal from the fire alarm system. Wiring from the fire alarm device to the motor starters provided under Division 26. Provide status of each fan and alarm the DDC system if a fan fails to start.

- G. Freeze Protection: Provide a manual reset freeze stat across the heating coil to stop the fan, close the outside air damper, fully open heating control valve, and alarm the DDC system if the freeze stat trips.
- H. Hot Heating Coil: During occupied periods system modulates control valve to maintain supply air temperature occupied set-point. During unoccupied periods, cycle valve to maintain unoccupied set-point. A discharge air sensor shall provide a discharge air low limit by modulating the heating valve to prevent the discharge air from falling below set point. A mixed air sensor located in the mixing box, averaging type, shall monitor the mixed air temperature. Provide mixed air reset.
- I. Cooling: Modulate 3-way control valve to maintain supply air temperature setpoint.
- J. Unoccupied: Supply and return fans shall remain off. The outside air, return air, and exhaust air dampers shall be in their normal state. The space sensor shall cycle the fans, at minimal speed, and heating valve to maintain night set back temperature. A push button override on the space sensor shall allow the Air Handler to operate in the occupied mode for a predetermined time.
- K. Control points to be provided and shown on the graphic page are as follows:
  1. DDC system graphic.
  2. DDC system on-off indication.
  3. DDC system occupied/unoccupied mode.
  4. Damper position of each damper.
  5. Outdoor airflow setpoint, minimum, and actual measured, CFM.
  6. Outdoor-air-temperature indication.
  7. Exhaust air-temperature indication.
  8. Supply-air-temperature indication.
  9. Supply-air-temperature setpoint.
  10. Return air-temperature indication.
  11. Heating-coil control-valve position.
  12. Cooling coil 3-way valve position.
  13. Smoke detection alarm.
  14. Each Fan Status.
  15. Each Fan Speed.
  16. VFD frequency and % speed.
  17. Mixed Air Temperature.
  18. Mixed Air Temperature Set Point.
  19. Freeze Protection Alarm.
  20. Return main CO2 Level.

#### 1.10 TOILET EXHAUST ENERGY RECOVERY UNIT CONTROL SEQUENCE (ERU-1, 2, 3)

- A. Air handling system shall start through DDC system provided all safeties have been satisfied.
- B. Fan Control: System commands constant volume supply and exhaust fans to run continuously when building is occupied. Signal alarm if either fan fails to start as commanded.
- C. Stop Mode: The supply fan and exhaust fans will be off, the outside air damper will be closed, and the heating valve will be full open.
- D. Smoke detection: Stop fans, and return system to STOP mode upon a signal from the fire alarm system. Wiring from the fire alarm device to the motor starters provided under Division 26.
- E. Hydronic Heating Coil (furnished exterior to unit): During occupied periods system modulates control valve to maintain supply air temperature occupied set-point. During unoccupied periods, cycle control valve to maintain unoccupied set-point.

- F. Freeze Protection: Provide a manual reset freeze stat across the heating coil to stop the fan, close the outside air damper, fully open heating control valve, and alarm the DDC system if the freeze stat trips.
- G. Control points to be provided and shown on the graphic page are as follows:
  1. DDC system graphic.
  2. DDC system on-off indication.
  3. DDC system occupied/unoccupied mode.
  4. Outdoor-air-temperature indication.
  5. Exhaust air-temperature indication.
  6. Supply-air-temperature indication.
  7. Supply-air-temperature setpoint.
  8. Return air-temperature indication.
  9. Heating-coil control-valve position.
  10. Smoke detection alarm.

#### 1.11 TERMINAL UNIT CONTROL SEQUENCES

##### A. Variable Air Volume (VAV) Terminal Units - OFFICE AREAS

1. Modulate terminal unit damper to maintain space temperature setpoint. On rise of space temperature above the cooling setpoint modulate terminal unit to its maximum airflow. As space temperature drops below the cooling setpoint modulate terminal unit to its minimum airflow. Upon further drop in zone temperature modulate the two-way heating control valve serving the terminal unit reheat coil to maintain zone setpoint.
2. Control points to be provided and shown on the graphic page are as follows:
  - a. Space temperature and set point
  - b. Damper position
  - c. Valve position

##### B. Variable Air Volume (VAV) Terminal Units - CLASSROOMS

1. Occupied mode: Wall mounted space occupancy sensor and CO2 sensor shall modulate terminal unit damper position between scheduled minimum and maximum airflow positions to maintain space CO2 levels under 1000ppm based on space occupancy. On rise of space CO2 above setpoint damper position shall be fully open and signal alarm to the DDC system.
2. Unoccupied Mode: Terminal unit damper shall modulate to scheduled minimum position to unoccupied scheduled airflow.
3. Provide manual override (unoccupied to occupied modes).
4. Control points to be provided and shown on the graphic page are as follows:
  - a. Supply air temperature at terminal unit.
  - b. Terminal Unit damper position.
  - c. Occupied / unoccupied status.
  - d. Space CO2 level indication.
  - e. Space CO2 alarm.

##### C. Unit Heaters:

1. A space thermostat, non-DDC, shall open the control valve and cycle the fan subject to a an aquastat on the hot water return pipe sensing that there is hot water available.

##### D. Cabinet Unit Heaters:

1. A space thermostat, non-DDC, shall open the control valve and cycle the fan subject to a an aquastat on the hot water return pipe sensing that there is hot water available.

E. Radiant Ceiling Heating Panels:

1. Room sensor modulates 2-way control valve to maintain zone temperature setpoint (adjustable). Provide manual override (unoccupied to occupied modes).
2. In zones and spaces where Radiant Panels are provided supplemental to air terminal units with reheat coils the radiant panel shall be secondary stage of heating.
3. Control points to be provided and shown on the graphic page are as follows:
  - a. Room/area served.
  - b. Room occupied/unoccupied.
  - c. Room temperature.
  - d. Room temperature set point, occupied.
  - e. Room temperature set point, occupied standby.
  - f. Room temperature set point, unoccupied.
  - g. Valve position.

1.12 MINI-SPLIT AIR CONDITIONING UNITS

1. Indoor evaporator unit and outdoor condensing unit shall be provided with self-contained controls (by mini-split equipment manufacturer.)
2. Provide space temperature sensor for monitoring room temperature thru DDC System. Provide alarm when space temperature risers above space thermostat set point 78 deg. F (adjustable).
  - a. Control points to be provided and shown on the graphic page are as follows:
    - 1) Room/area served.
    - 2) Room temperature.
    - 3) Room temperature set point, occupied.
    - 4) High space temperature alarm.

1.13 GENERAL EXHAUST CONROL SEQUENCES

A. EF-2, 3: (General Toilet Room Exhaust)

1. Exhaust fan schedule shall match facility occupancy schedule. Exhaust fan shall run continuously when in occupied mode.
2. Control points to be provided and shown on the graphic page are as follows:
  - a. Fan status.
  - b. Schedule.

B. EF-1, 7, 8 (Electrical Room /Elevator Machine Room Ventilation)

1. On temperature rise above 80 deg F (adjustable), outdoor air motorized damper shall open and space temperature sensor shall cycle fan to maintain room temperature setpoint. Outdoor air damper shall be closed and fan off when space temperature is below setpoint.

2. Control points to be provided and shown on the graphic page are as follows:
  - a. Fan status.
  - b. Damper position.

C. EF-6, 9: (Copier Exhaust Local Ventilation)

1. Manual local wall switch (variable speed controller furnished with fan) shall energize fan.
2. Control points to be provided and shown on the graphic page are as follows:
  - a. Fan status.
  - b. Alarm Status.

D. DBF-1: (Clothes Dryer Exhaust Booster)

1. Fan shall be interlocked (controls furnished with fan) to operate with dryer.
2. Control points to be provided and shown on the graphic page are as follows:
  - a. Fan status.
  - b. Alarm Status.

1.14 KITCHEN VENTILATION CONTROL SEQUENCE (MAU-1, EF-C5)

1. Make Up Air Unit (MAU-1)
  - a. Unit specified furnished with factory mounted integral controls package. Refer to Section **237339** "Outdoor, Direct Gas-Fired Heating and Ventilating Units" for components and sequence of operation.
  - b. Air handling system shall start through DDC system provided all safeties have been satisfied.
  - c. Stop Mode: The supply fan will be off, the outside air damper will be closed.
  - d. Smoke detection: Stop fan, and return system to STOP mode upon a signal from the fire alarm system. Wiring from the fire alarm device to the motor starters provided under Division 26.
  - e. Gas Heat: Modulates gas control valve to maintain supply air temperature set-point. During unoccupied periods, modulate valve to maintain unoccupied set-point.
  - f. In the event the Kitchen Grease Hood fire suppression system discharges:
    - 1) Make-up air supplied to the Kitchen Grease Hood shall be shut-off.
    - 2) Exhaust fan shall continue to operate after the extinguishing system has activated.
  - g. Control points to be provided and shown on the graphic page are as follows:
    - 1) DDC system graphic.
    - 2) DDC system on-off indication.
    - 3) DDC system occupied/unoccupied mode.
    - 4) Outdoor-air-temperature indication.
    - 5) Supply-air-temperature indication.
    - 6) Supply-air-temperature setpoint.
    - 7) Gas control-valve position.
    - 8) Smoke detection alarm.

2. Kitchen Grease Hood Exhaust (EF-5)
  - a. Hood specified furnished with factory mounted integral controls package. Refer to Section 233813 “Commercial Kitchen Hoods” for components and sequence of operation.
  - b. Control points to be provided and shown on the graphic page are as follows:
    - 1) DDC system graphic.
    - 2) Fan on-off indication.
    - 3) Alarm status.

#### 1.15 PLUMBING EQUIPMENT CONTROL AND MONITORING SEQUENCES

##### A. Elevator Sump Pit Pump (SP-1):

1. Provide alarm points to monitor the oil minder pump.
2. Control points to be provided and shown on the graphic page are as follows:
  - a. Alarm Status.
  - b. Pump Status.

##### B. Domestic Hot Water:

1. Provide sensor to monitor the distribution system temperatures.
2. Control points to be provided and shown on the graphic page are as follows:
  - a. 140 deg F distribution system temperature.
  - b. 115 deg F distribution system temperature.
  - c. Alarm Status.

##### C. Domestic Hot Water Recirculation Pumps (RP-1, 2):

1. Provide an occupied and unoccupied schedule. A domestic hot water return sensor shall enable the pump whenever the domestic hot water is below 120 F (adjustable set-point).
2. Control points to be provided and shown on the graphic page are as follows:
  - a. Pump Status.
  - b. Alarm Status.
  - c. Schedule.

##### D. Solar Domestic Hot Water

#### 1.16 MONITORING

- A. In addition to the points indicated in this section for specific equipment sequences and operation, provide Monitoring and Logging of Mechanical & Electrical Systems, per Division 23 Section “Instrumentation and Control for HVAC”.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

## SECTION 231113 - FUEL-OIL SYSTEM

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections;
  - 1. Earthwork - Division 02.
  - 2. Concrete - Division 03.

## 1.2 SUMMARY

- A. This Section includes fuel-oil distribution systems and the following:
  - 1. Pipes, tubes, and fittings.
  - 2. Piping and tubing joining materials.
  - 3. Piping specialties.
  - 4. Valves.
  - 5. Underground fuel oil storage tank.
  - 6. Underground fuel-oil storage tank piping specialties.
  - 7. Fuel-transfer pumps with daytank.
  - 8. Leak-detection and monitoring system.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working-Pressure Rating: Unless otherwise indicated, minimum pressure requirement for fuel oil piping is 150 psig.
- B. Delegated Design: Design restraint and anchors for fuel-oil piping, UTSS, and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Seismic Performance: Factory-installed support attachments for AST shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Also include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Piping specialties.
  2. Valves: Include pressure rating, capacity, settings, and electrical connection data of selected models.
  3. Underground fuel oil storage tank.
  4. Underground fuel-oil storage tank piping specialties.
  5. UST Manufacturer's Calibration Charts.
  6. MDEP Tank Registration Forms.
  7. U.L. Certification Plate.
  8. Fuel-oil transfer pumps.
  9. Liquid-level gage system.
  10. Leak-detection and monitoring system.
- B. Shop Drawings: For underground fuel oil storage tanks include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, manways, pipe connections, deadman and location and size of each field connection.
- C. Delegated-Design Submittal: For fuel-oil piping and equipment 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. Detail fabrication and assembly of anchors and seismic restraints.
  2. Design Calculations: Calculate requirements for selecting seismic restraints.
  3. Detail fabrication and assembly of pipe anchors, hangers, supports for multiple pipes, and attachments of the same to building structure.
- D. Qualification Data: For qualified professional engineer.
- E. Seismic Qualification Certificates: For UST, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For fuel-oil equipment and accessories to include in emergency, operation, and maintenance manuals.
- 1.5 QUALITY ASSURANCE
- A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- B. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.



- D. Comply with NFPA 30, "Flammable and Combustible Liquids Code," and NFPA 31, "Installation of Oil Burning Equipment," for fuel oil piping materials, components, installations, inspection, and testing.
- E. Fuel oil burner and appurtenances shall comply with current regulations of State of Maine Oil and Solid Fuel Board Laws and Rules.
- F. Underground fuel oil storage tanks and appurtenances shall be in compliance with EPA, State of Maine Department of Environmental Protection, and local authorities having jurisdiction.
- G. 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.
- H. Comply with ASME B31.9, "Building Services Piping," for fuel-oil piping materials, installation, testing, and inspecting.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Lift and support fuel-oil storage tanks only at designated lifting or supporting points, as shown on Shop Drawings. Do not move or lift tanks unless empty.
- 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 pipes and tubes with protective PE coating to avoid damaging the coating and to protect from direct sunlight.
- D. Store PE pipes and valves protected from direct sunlight.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

### PART 2 - PRODUCTS

#### 2.1 UNDERGROUND FUEL OIL STORAGE TANKS AND ACCESSORIES

- A. Acceptable manufacturers:
  - a. Containment Solutions Inc., Conroe, TX
  - b. Xerxes Corp., Minneapolis, MN
- B. Double wall Fiberglass-Reinforced plastic (FRP) Underground Storage Tanks shall be nominal gallon capacity as shown. Tanks to be as follows: Tanks to be as specified and as shown on drawings. Double wall FRP tanks to have a primary (internal tank) and a secondary (external) tank. Other criteria to be as follows:
  - 1. All tanks, primary, secondary, etc., shall be manufactured with 100% isophthalic polyester resin and glass fiber reinforcement with sand fillers.

2. Annular Space: Tanks shall have a space between primary and secondary shell walls to allow free flow and containment of all leaked product from the primary tank. Space shall also be sufficient to insert a monitoring device through a monitoring fitting.
- C. Capacities and Characteristics:
1. Capacity: Nominal 12,000 gallon minimum
  2. Diameter: 8'-0"
  3. Length: 36'-0"
- D. Loading Conditions - Tank shall meet the following design criteria:
1. External hydrostatic pressure: Buried in ground with 7' of overburden over the top of the tank. The hole fully flooded and a safety factor of 5:1 against general buckling.
  2. Surface Loads: When installed according to manufacturer's installation instructions tanks shall withstand surface H-20 axle loads.
  3. Internal Load: All tanks (primary, secondary, etc.) shall withstand 5 psi air pressure test with 5 to 1 safety factor. Test prior to installation since this design condition is to test for leakage.
  4. Tanks shall be designed to support accessory equipment such as heating coils, ladders, drop tubes, etc. mounted through 4" NPT couplings when installed according to manufacturer's recommendations and limitations.
  5. Vacuum Test - For structural integrity, 11.5" primary and 9.5" secondary (mercury vacuum).
- E. Product Storage Requirements:
1. All tanks must be vented, as tanks are designed for operation at atmospheric pressure only. Vent primary tank to atmospheric pressure at 6 feet minimum above finish grade. Do not design tanks as pressure vessels.
  2. Tanks shall be capable of storing liquids with specific gravity up to 1.1.
  3. Maximum temperature. Tanks shall be capable of storing liquids up to a maintained temperature of 150 Degrees F at the tank interior surface.
  4. Tanks shall be chemically inert to petroleum products.
  5. Tank shall have 30 year limited warranty against failure due to internal/external corrosion.
- F. Accessories:
1. Anchor Straps - Provide fiber glass-reinforced plastic anchor straps, turnbuckles and deadmen anchors for each tank shown. Number and location shall be as specified by manufacturer and as indicated. Each strap shall be capable of withstanding the buoyancy load for the as recommended by tank manufacturer for diameter shown. Straps shall be standard as supplied by the tank manufacturer.
  2. Certification Plate - Underwriter's Laboratory label shall be permanently affixed to each tank.
  3. Fill Tubes:
    - a. Provide mechanical overfill equal to OPW model 61.

- 5. Fittings-Threaded – NPT
  - a. All threaded fittings on U.L. labeled tanks shall be of a material of construction consistent with the requirements of the U.L. label. All fittings to be supplied with cast iron plugs.
  - b. All standard threaded fittings are 4" in diameter and shall be half couplings. Reducers are to be used for smaller sizes where specified and provided by contractor.
  - c. Threaded Standards - All threaded fittings shall have machine tolerance in accordance with the ANSI Standard for each fitting size.
  - d. Strength - NPT fittings will withstand a minimum of 150 foot-pounds of torque and 1,000 foot-pounds of bending, both with 2:1 factor of safety.

Sizes	Standard
Inlet	4"
Outlet	4"
Vent	4"
Gauge	4"
Fill	4"

- 6. Lifting Lugs - Provide lifting lug(s) on all tanks. Lugs shall be capable of withstanding weight of tank with a safety factory of 3 to 1.
- 7. Furnish calibrated stick and chart for tank.
- 8. Provide and install at the end of the vent pipe a 2" type T mushroom vent with insect screen as manufactured by Preferred Utilities or equal.
- 9. Furnish and install tank fill spill container for each tank capable of storing a minimum of 15 gallons. Storage tank fill lines shall terminate in a spill container, including a composite top-seal, tight fill adapter and locking fill cap. To prevent damage from frost heave, normal settling, or roadway traffic, the spill compartment shall have a flexible bellows protected by a ribbed gravel shroud. The spill compartment shall be readily removable to allow soil testing directly through the spill container - without breaking concrete. The drain valve shall close with tank pressure to help prevent leakage during tank testing or filling. Hand operated pump with hose assembly. Spill draining is through an internal passage. The spill container shall be equal to Fairfield Industries, Inc., SCM-15.
- 10. Installation and Testing: Tanks shall be tested and installed according to the current installation instructions provided with the tank. Tank installation shall be in strict accordance with current State of Maine, Department of Environmental Protection Regulations and performed by a State of Maine Licensed Tank Installer.
- 11. Manways: To be flanged and 38" ID with all accessories - gaskets, bolts, covers, all to be UL listed. Provide manway risers and sumps as indicated on plans.
- 12. Install gage plates under each fitting.
- 13. Provide suction and return lines of sizes and quantity as indicated on drawings.
- 14. Monitor Fittings: A 4" NPT monitor fitting on the secondary tank.

## 2.2 TANK GAUGING AND MONITORING SYSTEM

- A. Tank Gauging and Monitoring: All components of the tank monitoring system and accessories shall be compatible.
1. Provide for each double wall tank a remote reading, microprocessor based tank gauging and leak monitoring system. The system shall include an indicating instrument, direct-lift float actuated level sensor and leak detector(s) for the annular space and double wall piping sump. The instrument shall have a die cast aluminum housing, provide a continuous 0.8" digital indication of tank contents directly in gallons, on-demand indication of contents in inches, English language alarm displays, and shall contain all calibration adjustments. Flush mounted on the unit shall be an audible alarm and push-buttons for liquid depth, alarm silencing and data recall. The system shall provide a 4-20 mA output proportional to tank content in gallons and isolated alarm relay contacts for leak detection/theft loss, low liquid level, common alarm, and an automatically silenced overflow alarm. All leak detectors shall be normally energized with a failure causing the leak alarm contacts to close.
  2. Wiring: Use minimum 20 gauge wire tape all exposed shields, for interconnection of remote devices to system equipment. Connect shields only where shown. Do not run in conduits with AC wiring. Install shielded cable in plastic. Conduit shall be 2" diameter minimum.
  3. The interstitial space monitoring shall be able to detect a leak from the primary containment structure of at least 0.2 gallons per hour or 150 gallons within 30 days of a leak or discharge with a 95 percent probability of detection and a 5 percent probability of false alarm.
  4. Coordinate requirements as required to integrate alarm monitoring and tank liquid level with building HVAC automated controls systems.
  5. Overflow warning signals equal to Pneumercator Model LC1000 to provide advance warning to delivery person of a full tank condition coordinate location with Owner. Provide overflow prevention valve that will automatically shut off flow into the tank when it is no more than 95 percent full or alert the transfer operator when the tank is no more than 90 percent full by restricting flow into the tank..
  6. Street Box: Shall be heavy duty cast iron cast in place watertight manhole, frame with bolted cover.
    - a. Basis of Design:
      - 1) Fairfield model 180 MW
- B. Calibration: Manufacturer of tank gauging and monitoring system shall provide one day of on site start-up and calibration of all gauge and leak system equipment, for each tank.

## 2.3 PIPES, TUBES, AND FITTINGS

- A. See Part 3 piping schedule articles for where pipes, tubes, fittings, and joining materials are applied in various services.
- B. 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. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  3. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

- a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

## 2.4 DOUBLE-CONTAINMENT PIPE AND FITTINGS

### A. Flexible, Double-Containment Piping:

1. Manufacturer:
  - a. Environ GeoFlex.
2. Piping systems and fittings shall be in compliance with UL-971 and State of Maine DEP regulations.
3. All fuel oil supply and return piping shall be approved flexible double wall pipe with primary and secondary piping.
4. System piping runs shall be continuous from tank to building.
5. Watertight sump entry boots, pipe adapters with test ports and tubes, coaxial fittings, and couplings.
6. Plastic to Steel Pipe Transition Fittings: Factory-fabricated fittings with plastic end matching or compatible with carrier piping, and steel pipe end complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
7. Include design and fabrication of double-containment pipe and fitting assemblies with provision for field installation of cable leak-detection system in annular space between carrier and containment piping.

### B. Flexible, Corrugated Conduit:

1. Manufacturer:
  - a. Environ GeoDuct, nominal 4.5" O.D.
2. Piping systems and fittings shall be in compliance with UL-971 and State of Maine DEP regulations.
3. System piping runs shall be continuous from tank to building.

## 2.5 PIPING SPECIALTIES

### A. Flexible Connectors: Comply with UL 567.

1. Metallic Connectors:
  - a. Listed and labeled for aboveground and underground applications by an NRTL acceptable to authorities having jurisdiction.
  - b. Stainless-steel bellows with woven, flexible, bronze or stainless-steel, wire-reinforcing protective jacket.
  - c. Minimum Operating Pressure: 150 psig.
  - d. End Connections: Socket, flanged, or threaded end to match connected piping.
  - e. Maximum Length: 30 inches

- f. Swivel end, 50-psig maximum operating pressure.
- g. Factory-furnished anode.

## 2.6 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for fuel oil.
- B. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

## 2.7 MANUAL FUEL-OIL SHUTOFF VALVES

- A. See valve schedule in Part 3 for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller for Liquid Service: Comply with UL 842.
  - 1. CWP Rating: 125 psig.
  - 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 the valve schedule.
  - 5. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with UL 842.
  - 1. CWP Rating: 125 psig.
  - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
  - 3. Tamperproof Feature: Locking feature for valves indicated in the valve schedule.
  - 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.
  - 1. Body: Bronze, complying with ASTM B 584.
  - 2. Ball: Chrome-plated bronze.
  - 3. Stem: Bronze; blowout proof.
  - 4. Seats: Reinforced TFE; blowout proof.
  - 5. Packing: Threaded-body packnut design with adjustable-stem packing.
  - 6. Ends: Threaded, flared, or socket as indicated in the valve schedule.
  - 7. CWP Rating: 600 psig.
  - 8. Service Mark: Initials "WOG" shall be permanently marked on valve body.

## 2.8 SPECIALTY VALVES

- A. Oil Safety Valves: Comply with UL 842.
  - 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. Anderson Greenwood; Division of Tyco Flow Control.
    - b. Suntec Industries Incorporated.
    - c. Webster Fuel Pumps & Valves; a division of Capital City Tool, Inc.
  - 2. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
  - 3. Body: Brass, bronze, or cast steel.

4. Springs: Stainless steel.
  5. Seat and Diaphragm: Nitrile rubber.
  6. Orifice: Stainless steel, interchangeable.
  7. Factory-Applied Finish: Baked enamel.
  8. Manual override port.
- B. Emergency Shutoff Valves: Comply with UL 842.
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. Ameron International; Fiberglass Pipe Group.
    - b. Conley Corporation.
    - c. EMCO Wheaton; a Gardner Denver Company.
    - d. Environ Products, Inc.
    - e. OPW.
  2. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
  3. Body: ASTM A 126, cast iron.
  4. Disk: FPM.
  5. Poppet Spring: Stainless steel.
  6. Stem: Plated brass.
  7. O-Ring: FPM.
  8. Packing Nut: PTFE-coated brass.
  9. Fusible link to close valve at 165 deg F.
  10. Thermal relief to vent line pressure buildup due to fire.
  11. Air test port.
  12. Maximum Operating Pressure: 0.5 psig.

## 2.9 DUPLEX TRANSFER PUMPS WITH DAYTANK

- A. Basis-of-Design Product: Subject to compliance with requirements, provide equal to PY75UL-385F-395-427A-461-464-TUI as manufactured by Pryco Manufacturing.
- B. Supply a 75-gallon UL listed day tank with additional internal reinforcement, properly sized emergency vent and a 150% UL listed rupture basin with a capacity of not less than 75 gallons. Tank and rupture basin to have UL label.
- C. Unit shall include:
1. Removable inspection plate with gasket.
  2. Two (2) 2 gpm pump with 1/3 hp motors.
  3. Auxiliary hand pump.
  4. Fuel level gauge.
  5. Heavy duty float switch.
  6. "Press to test" switch.
  7. "Pump running" indicator light.
  8. Four 1" NPT threaded pipe connections.
  9. One 2" NPT vent connection.
  10. Lift lugs.
  11. Removable top cover.
  12. Epoxy coating inside.
  13. Medium gray exterior paint (or industrial color of choice).

- D. Critical high fuel pump/motor shut down. Separate float switch that shuts off the pump and motor when fuel rises to 103% level. Includes a “critical high” red light on the control panel that is activated; a remote annunciation relay is closed and dry contacts are activated. A “normally open” solenoid valve is closed to prevent further fuel from entering the tank.
- E. Rupture basin. 150% tank capacity for a 75-gallon tank, UL listed.
- F. Rupture basin leak detector. Sensor shuts down the pump motor; activates a “rupture detected” red light on the control panel and activates dry contacts for remote signal (15 amp).
- G. Automatic transfer switch for duplex pumping system. A second motor controlling switch. The first pump-motor operates at 86% of useable fuel capacity; the second pump-motor operates at 82% of useable fuel capacity. Both pump-motors shut off at 100% capacity. Included is a transfer switch that will automatically alternate each pump-motor into the lead start position. The assembly also includes an HOA switch for pump “Run-Off-Auto” mode selection and a “pump running” amber light for each pump/motor.
- H. Duplex strainer with 3-way valves. (shipped loose)
- I. Pipe stems. Additional 3 sets of two drop tubes with 1” NPT connections for supplying additional appliances.
- J. Tank to be constructed with heavy gauge steel using certified welders. Tank is to comply with NFPA 30 and be tested to 5 psi.
- K. Emergency vent. Properly sized emergency relief vent to meet UL requirements.
- L. Provide with controls for integration with the Buildings Automated Controls for system monitoring.

## 2.10 LEAK-DETECTION AND MONITORING SYSTEM

- A. Cable and Sensor System: Comply with UL 1238.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Pneumercator Inc. TMS 2000 or comparable product by one of the following:
    - a. Containment Solutions, Inc.
    - b. EBW, Inc.
    - c. Gems Sensors Inc..
    - d. In-Situ, Inc.
    - e. MSA; Instrument Div.
    - f. Perma-Pipe, Inc.
    - g. Pneumercator Inc..
    - h. Veeder-Root; a Danaher Corporation Company.
    - i. Incon Corp.
  - 2. Calibrated, leak-detection and monitoring system with probes and other sensors and remote alarm panel for fuel-oil storage tank and fuel-oil piping.
  - 3. Include fittings and devices required for testing.
  - 4. Controls: Electrical, operating on 120-V ac.
  - 5. Calibrated, liquid-level gage complying with or other sensors and remote annunciator panel.



6. Remote Annunciator Panel: Model EDT-1000 TUI with visual and audible alarm for high-tank-level and low-tank-level alarms, fuel level indicator with registration in gallons, and overflow alarm. Include gage volume range that covers fuel-oil storage capacity. Include relay card.
7. Remote monitoring/alarm 4-20 mA isolated output to control panel, as required for integration with buildings automated controls for system monitoring.
8. Liquid Level Probe equal to Pneumercator Inc. MP-450
9. Dual float kit U4K2
10. Leak switch equal to Pneumercator Inc. LS600-LD-BN

#### 2.11 FUEL OIL

- A. Fuel Oil: ASTM D 396, Grade No. 2.

#### 2.12 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

#### 2.13 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine roughing-in for fuel-oil 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 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

#### 3.3 PREPARATION

- A. Close equipment shutoff valves before turning off fuel oil to premises or piping section.
- B. Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

- C. Tank installations shall meet all State of Maine Regulations, including Department of Environmental Protection.
- D. File MDEP Tank Registration Forms for underground oil and petroleum products storage tanks 5 days prior to starting work. See attachments.
- E. Obtain and purchase all permits required to install tank.

#### 3.4 INSTALLATION OF FUEL TANK AND ACCESSORIES

- A. Install tanks and piping according to manufacturer's current double wall installation instructions and performed by a State of Maine Licensed Tank Installer:

1. Tanks: All new and replacement tanks must be installed in accordance with manufacturer's instructions and the following nationally accepted codes of practice: American Petroleum Institute Publication 1615, "Installation of Underground Petroleum Storage Systems", Petroleum Equipment Institute (PEI) Publication RP100-90, "Recommended Practices for Installation of Underground Liquid Storage Systems"; and National Fire Protection Association Code 30, 30A or 31.

NOTE: Tank installation instructions may require specific aggregate sized peastone or gravel. Instructions may also specify mechanical compaction or layered placement of bedding and backfill. Always consult the installation instructions provided by the manufacturer, prior to installation.

2. New underground tanks will be tested for tightness before being covered or placed in use by a pneumatic test conducted in conformance with the requirements of Appendix C or another test method approved by the Commissioner.

NOTE: Air pressure testing will not be conducted after petroleum product has been placed in the tank. Air pressure testing when petroleum vapors are present in the tank may result in explosion of the tank.

3. All temporary supports must be removed prior to final backfilling.
4. All electrical wiring shall be performed in accordance with the current State of Maine electrical code.
5. Anchoring of tanks shall be required where tanks will be installed in areas where groundwater will be in contact with the tank or where located within a 100 year flood plain as mapped by the Federal Emergency Management Agency (FEMA) or if such mapping is unavailable, as determined by the flood of record or by the presence of floor plain soils. When anchoring tanks equipped with cathodic protection, the hold down must be electrically isolated from the tank. Anchoring of all tanks shall be performed in accordance with the tank manufacturer's specification of PEI Publication RP 100-90.

NOTE: FEMA floor plain maps are available for inspection at most municipal offices.

- B. Piping

1. All new and replacement piping must be installed in accordance with the manufacturer's instructions and the following nationally accepted codes of practice: American Petroleum Institute Publication 1615, "Installation of Underground Petroleum Storage Systems", Petroleum Equipment Institute (PEI) Publication RP100-90, "Recommended Practices for Installation of Underground Liquid Storage Systems", and STI Standard R 892.

2. Before underground piping is installed, the trench shall receive as a minimum a 6-inch deep bed of well compacted noncorrosive material such as clean sand, pea stone and gravel. All trenches shall be wide enough to permit at least 6 inches of noncorrosive backfill material around all lines.
  3. Prior to being covered or placed in service, all new and replacement piping shall be pneumatically tested for tightness.
  4. All temporary supports shall be removed prior to backfilling.
  5. Fill piping for storage of Class I liquids shall be set back from any building opening in accordance with National Fire Protection Association Codes 30, 30A or 31.
  6. Product supply lines which are used in conjunction with pressurized pumping systems shall be installed with a product line leak detection device. All leak detection devices shall be tested for proper operation before the remote pumping system is used after initial installation and once annually thereafter. All leak detectors shall be capable of detecting a leak at a rate of at least 3 gallons per hour at a line pressure of 10 psi within one hour of occurrence with a 95 percent probability of detection and a five (5) percent probability of false alarm.
  7. A crash valve shall be installed under dispensers of pressurized pumping systems in accordance with the National Fire Protection Code 30A.
  8. Conventional suction systems shall have no more than one check valve per pump. The check valve shall be located as close to the pump as possible, such that any leaks in the line will result in a return of product to the tank. Supply and return piping for a facility storing oil for an emergency standby generator are exempt from this requirement if secondary containment with continuous interstitial space monitoring is provided in accordance with Section 5(B)(2) of this rule.
- C. Test tanks and piping according to manufacturer's current double wall installation instructions.
1. Air pressure testing of tanks and piping shall only be performed on new, empty tanks and piping, which have never contained product.
  2. When conducting an air pressure test on metallic tanks and piping, all external joints, seams and connections shall be soaped. For fiberglass tanks and piping the entire surface as well as joints and connections shall be soaped.
  3. The test shall be maintained for a minimum of 1 hour, and all soaped areas shall be visually inspected for bubbles or any other indication of a leak.
  4. Any loss of pressure or appearance of bubbles shall constitute failure of the test.
  5. Underground piping shall be physically isolated from the tank prior to the test.
  6. Underground piping shall be tested to 150% of the maximum anticipated pressure of the system, but not less than fifty (50) pounds per square inch (psi) gauge at the highest point of the system.
  7. Tanks shall be tested before being covered, enclosed or placed in service.
  8. Tanks shall be tested at not less than three (3) pounds per square inch (psi) and not more than five (5) pounds per square inch (psi) gauge. Gauges used during air testing of tanks shall have a maximum limit of 10-15 pounds per square inch (psi).

### 3.5 OUTDOOR PIPING INSTALLATION

- A. Install underground fuel-oil piping buried at least 18 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.
- B. Install double-containment, fuel-oil pipe at a minimum slope of 1 percent downward toward fuel-oil storage tank sump.
- C. Install vent pipe at a minimum slope of 2 percent downward toward fuel-oil storage tank sump.
- D. Assemble and install entry boots for pipe penetrations through sump sidewalls for liquid-tight joints.
- E. Install metal pipes and tubes, fittings, valves, and flexible connectors at piping connections to AST and UST.
- F. Install fittings for changes in direction in rigid pipe.
- G. Install system components with pressure rating equal to or greater than system operating pressure.
- H. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Install sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- I. Mechanical Sleeve Seal Installation: 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.

### 3.6 INDOOR PIPING INSTALLATION

- A. 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.
- B. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- 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 free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install escutcheons for penetrations of walls, ceilings, and floors.
- I. Fuel oil burner supply piping: Run exposed on supports from floor, schedule 40 steel pipe with steel or malleable-iron threaded fittings, and threaded joints.

- 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 "Penetration Firestopping."
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements for equipment specifications in Division 22 and Division 23 Sections for roughing-in requirements.
- M. Conceal pipe installations in walls, pipe spaces, or utility spaces; above ceilings; below grade or floors; and in floor channels unless indicated to be exposed to view.
- N. Prohibited Locations:
  - 1. Do not install fuel-oil piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
  - 2. Do not install fuel-oil piping in solid walls or partitions.
- O. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- P. Connect branch piping from top or side of horizontal piping.
- Q. Install unions in pipes NPS 2 and smaller at final connection to each piece of equipment and elsewhere as indicated. Unions are not required on flanged devices.
- R. Do not use fuel-oil piping as grounding electrode.

### 3.7 VALVE INSTALLATION

- A. Install manual fuel-oil shutoff valves on branch connections to fuel-oil appliance.
- B. Install valves in accessible locations.
- C. Protect valves from physical damage.
- D. Install metal tag attached with metal chain indicating fuel-oil piping systems.
- E. Identify valves as specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- F. Install oil safety valves at inlet of each oil-fired appliance.
- G. Install emergency shutoff valves at dispensers.

### 3.8 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: 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 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.

### 3.9 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

### 3.10 FUEL-OIL PUMP INSTALLATION

- A. Install two-piece, full-port ball valves at suction and discharge of pumps.
- B. Install check valve on discharge of simplex fuel-oil pumps.
- C. Install suction piping with minimum fittings and change of direction.

### 3.11 LEAK-DETECTION AND MONITORING SYSTEM INSTALLATION

- A. Install leak-detection and monitoring system. Install alarm panel inside building where indicated.
  1. Double-Containment, Fuel-Oil Piping: Install leak-detection sensor cable probes in interstitial space of double-containment piping.
  2. Install liquid-level gage.

### 3.12 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.
- C. Connect piping to equipment with ball valve and union. Install union between valve and equipment.
- D. Install flexible piping connectors at final connection to burners or oil-fired appliances that must be moved for maintenance access.
- E. Underground fuel oil storage tank leak detection system monitoring. Coordinate connection requirements with Division 23, Section "Instrumentation and Controls for HVAC" and Division 23, Section "Sequence of Operation for HVAC Controls".
- F. Day Tank and Transfer Pumps: Coordinate connection requirement with Division 23, Section "Instrumentation and Controls for HVAC" and Division 23, Section "Sequence of Operation for HVAC Controls".

## 3.13 LABELING AND IDENTIFYING

- A. Nameplates, pipe identification, and signs are specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on or near each service regulator, service meter, and earthquake valve.
  - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Install detectable warning tape directly above fuel-oil piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs. Terminate tracer wire in an accessible area, and identify as "tracer wire" for future use with plastic-laminate sign.
  - 1. Piping: Over underground fuel-oil distribution piping.
  - 2. Fuel-Oil Storage Tanks: Over edges of each UST.

## 3.14 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain leak-detection and monitoring systems.

## 3.15 OUTDOOR PIPING SCHEDULE

- A. Underground fuel-oil piping shall be the following. Size indicated is carrier-pipe size.
  - 1. Flexible, double-containment piping.
- B. Underground fuel-oil piping shall be the following:
  - 1. Flexible, double-containment piping.
- C. Aboveground fuel-oil piping shall be the following:
  - 1. NPS 2 and Smaller: Galvanized steel pipe, steel or malleable-iron threaded fittings, and threaded joints.

## 3.16 INDOOR PIPING SCHEDULE

- A. Aboveground fuel-oil piping shall be the following:
  - 1. NPS 5/8 to NPS 2: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints.

## 3.17 ABOVEGROUND MANUAL FUEL-OIL SHUTOFF VALVE SCHEDULE

- A. Distribution piping valves for pipe NPS 2 and smaller shall be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.

3.18 RESPONSIBILITIES OF THE CONTRACTOR

- A. Provide complete operational fuel oil system.
- B. Provide required notice to DEP and Local Fire Department.
- C. Provide Facility registration amendment.
- D. Provide a copy of the spiral-bound operations and maintenance manuals to: Owner; Project Engineer; with all warranties for all items included.

END OF SECTION 231113



## SECTION 232113 - HYDRONIC 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 pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
  - 1. Hot-water heating piping.
  - 2. Makeup-water piping.
  - 3. Safety-valve-inlet and -outlet piping.
- B. Related Sections include the following:
  - 1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

## 1.3 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
  - 1. Hot-Water Heating Piping: 125 psig at 200 deg F.
  - 2. Makeup-Water Piping: 80 psig at.
  - 3. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

## 1.5 SUBMITTALS

- A. Product Data: For each type of the following:
  - 1. Pipe and fittings.
  - 2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
  - 3. Air control devices.
  - 4. Hydronic specialties.
- B. Welding certificates.

- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  - 1. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

### PART 2 - PRODUCTS

#### 2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. DWV Copper Tubing: ASTM B 306, Type DWV.
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Wrought-Copper Unions: ASME B16.22.

#### 2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
- C. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

- D. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- E. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  - 1. Material Group: 1.1.
  - 2. End Connections: Butt welding.
  - 3. Facings: Raised face.
- F. Grooved Mechanical-Joint Fittings and Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International, Inc., Gruvlok
    - b. Grinnell Mechanical Products.
    - c. Victaulic Company of America.
  - 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
  - 3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
- G. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

### 2.3 PLASTIC PIPE AND FITTINGS

- A. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- B. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

### 2.4 JOINING MATERIALS

- A. 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 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. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

- E. Solvent Cements for Joining Plastic Piping:
  - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
    - 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).
- F. Use adhesive primer that has a VOC content of 550 g/L or less
- G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

## 2.5 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
  - 1. PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.
  - 2. Flanges matching piping systems.

## 2.6 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions:
  - 1. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges:
  - 1. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric-Flange Kits:
  - 1. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Nipples:
  - 1. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

## 2.7 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Bronze, Calibrated-Orifice, Balancing Valves:
  - 1. Basis-of-Design Product: Taco: Accu-Flo
  - 2. Body: Bronze, ball or plug type with calibrated orifice.
  - 3. Ball: Brass or stainless steel.
  - 4. Plug: Resin.
  - 5. Seat: PTFE.
  - 6. End Connections: Threaded.
  - 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
  - 8. Handle Style: Lever, with memory stop to retain set position.
  - 9. CWP Rating: Minimum 125 psig.
  - 10. Maximum Operating Temperature: 250 deg F.

## 2.8 AIR CONTROL DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amtrol, Inc.
  - 2. Armstrong Pumps, Inc.
  - 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
  - 4. Taco.
- B. Manual Air Vents:
  - 1. Body: Bronze.
  - 2. Internal Parts: Nonferrous.
  - 3. Operator: Screwdriver or thumbscrew.
  - 4. Inlet Connection: NPS 1/2.
  - 5. Discharge Connection: NPS 1/8.
  - 6. CWP Rating: 150 psig.
  - 7. Maximum Operating Temperature: 225 deg F.
- C. Automatic Air Vents:
  - 1. Body: Bronze or cast iron.
  - 2. Internal Parts: Nonferrous.
  - 3. Operator: Noncorrosive metal float.
  - 4. Inlet Connection: NPS 1/2.
  - 5. Discharge Connection: NPS 1/4.
  - 6. CWP Rating: 150 psig.
  - 7. Maximum Operating Temperature: 240 deg F.
- D. Bladder-Type Expansion Tanks:
  - 1. Basis of Design: Taco CBX.
  - 2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Micro-Bubble Air Separators:

1. Basis of Design: Taco 4900 Series.
2. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 270 deg F maximum operating temperature.
3. Media: High surface pall rings.
4. Vent Chamber: Brass construction with flushing cock.
5. Inlet and Outlet Connections: Threaded for NPS 3 and smaller.
6. Blowdown: Threaded connection with blowdown valve.
7. Performance, capacity, and size: Match system flow capacity, velocity, and as scheduled on the drawings.

## 2.9 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

B. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be either of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be either of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

- C. Makeup-water piping installed aboveground shall be the following:
  - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- D. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

### 3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

### 3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. 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.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- T. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

#### 3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
  - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
  - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
  - 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
  - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
  - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
  - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  - 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  - 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
  - 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
  - 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
  - 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
  - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
  - 3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  - 4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.



### 3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections 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. 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 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.
- F. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

### 3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- E. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

### 3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

### 3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
  - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
  - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
  - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
  - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
  - 3. Isolate expansion tanks and determine that hydronic system is full of water.
  - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
  - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
  - 6. Prepare written report of testing.
- C. Perform the following before operating the system:
  - 1. Open manual valves fully.
  - 2. Inspect pumps for proper rotation.
  - 3. Set makeup pressure-reducing valves for required system pressure.
  - 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
  - 5. Set temperature controls so all coils are calling for full flow.
  - 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers to specified values.
  - 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

## SECTION 232123 - HYDRONIC PUMPS

## 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. In-line, Sealless Centrifugal Pumps.
  - 2. Separately coupled, base-mounted, end-suction centrifugal pumps.

## 1.3 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

## 1.4 SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps 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.
- D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

## 1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
  - 1. Armstrong Pumps Inc.
  - 2. Bell & Gossett; Div. of ITT Industries.
  - 3. Goulds Pumps; Water Technologies Group.
  - 4. Grundfos Pumps Corp.
  - 5. PACO Pumps.
  - 6. Patterson Pump Co.; a Subsidiary of The Gorman-Rupp Co.
  - 7. Taco, Inc.
  - 8. Weinman; Div. of Crane Pumps & Systems.

### 2.2 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
- B. Performance: As Scheduled on the Drawings.
- C. Pump Construction:
  - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
  - 2. Casing: Bronze, with threaded or companion-flange connections.
  - 3. Impeller: Plastic.
  - 4. Motor: Single speed, unless otherwise indicated.
  - 5. Minimum Working Pressure: 125 psig.
  - 6. Maximum Continuous Operating Temperature: 220 deg F.

### 2.3 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 250 deg F.
- B. Performance: As Scheduled on the Drawings.
- C. Pump Construction:
1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide integral mount on volute to support the casing, and attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.
  2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
  3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
  4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket.
  5. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.
- D. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor EPDM coupling sleeve for variable-speed applications.
- E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
- F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.
- G. Motor: Single speed, with **[permanently lubricated]** **[grease-lubricated]** ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

### 2.4 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser: Angle pattern, 175-psig pressure rating, **[cast]** **[ductile]**-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.
- B. Triple-Duty Valve: Angle or straight pattern, 175-psig pressure rating, **[cast]** **[ductile]**-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 23 Section "Common Work Results for HVAC."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

### 3.3 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Install continuous-thread hanger rods and [**elastomeric hangers**] [**spring hangers**] [**spring hangers with vertical-limit stop**] of sufficient size to support pump weight. Vibration isolation devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- E. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.
  - 1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
  - 2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

### 3.4 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.
- B. Comply with pump and coupling manufacturers' written instructions.
- C. Adjust pump and motor shafts for angular and offset alignment by methods specified in [**HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation**]."
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

### 3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install [**check valve and throttling**] [**triple-duty**] valve on discharge side of pumps.
- F. Install [**suction diffuser**] and shutoff valve on suction side of pumps.
- G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- H. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.
- I. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- J. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Check piping connections for tightness.
  - 3. Clean strainers on suction piping.
  - 4. Perform the following startup checks for each pump before starting:
    - a. Verify bearing lubrication.
    - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    - c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 232123



## SECTION 232300 - REFRIGERANT 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 refrigerant piping used for air-conditioning applications.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-407C:
  - 1. Suction Lines for Air-Conditioning Applications: 230 psig.
  - 2. Hot-Gas and Liquid Lines: 380 psig.
- B. Line Test Pressure for Refrigerant R-410A:
  - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
  - 2. Hot-Gas and Liquid Lines: 535 psig.

## 1.4 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
  - 1. Thermostatic expansion valves.
  - 2. Solenoid valves.
  - 3. Strainers.
  - 4. Pressure-regulating valves.
- B. Welding certificates.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

#### 1.6 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

#### 1.7 COORDINATION

- A. Coordinate size and location of equipment supports, and wall penetrations.
- B. Coordinate with refrigerant piping specified and scheduled to be furnished with equipment.

### PART 2 - PRODUCTS

#### 2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Brazing Filler Metals: AWS A5.8.
- E. Flexible Connectors:
  - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
  - 2. End Connections: Socket ends.
  - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
  - 4. Pressure Rating: Factory test at minimum 500 psig.
  - 5. Maximum Operating Temperature: 250 deg F.

#### 2.2 VALVES AND SPECIALTIES

- A. Service Valves:
  - 1. Body: Forged brass with brass cap including key end to remove core.
  - 2. Core: Removable ball-type check valve with stainless-steel spring.
  - 3. Seat: Polytetrafluoroethylene.
  - 4. End Connections: Copper spring.
  - 5. Working Pressure Rating: 500 psig.
- B. Solenoid Valves: Furnished with Packaged Water Chiller, refer to Section 23 6400.
- C. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
  - 1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.

2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

D. Thermostatic Expansion Valves: Furnished with Packaged Water Chiller, refer to Section 23 6400.

E. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

F. Moisture/Liquid Indicators: Furnished with Packaged Water Chiller, refer to Section 23 6400.

### 2.3 REFRIGERANTS

- A. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.
- B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS FOR REFRIGERANT R-407C and R-410A

- A. Hot-Gas and Liquid Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

### 3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- B. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- C. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- D. Install thermostatic expansion valves as close as possible to distributors on evaporators.
  1. Install valve so diaphragm case is warmer than bulb.
  2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
  3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

- E. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- F. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- G. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
  - 1. Solenoid valves.
  - 2. Thermostatic expansion valves.
  - 3. Compressor.
- H. Install flexible connectors at compressors.

### 3.3 PIPING INSTALLATION

- A. 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 Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- 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 adjacent to machines to allow service and maintenance.
- 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. Refer to Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operation" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  2. Install traps and double risers to entrain oil in vertical runs.
  3. Liquid lines may be installed level.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- Q. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- S. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- T. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
- U. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

### 3.4 PIPE 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 pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
  2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

### 3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
1. Adjustable steel clevis hangers.
  2. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.

4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  1. Comply with ASME B31.5, Chapter VI.
  2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
  3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
    - a. Fill system with nitrogen to the required test pressure.
    - b. System shall maintain test pressure at the manifold gage throughout duration of test.
    - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

### 3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
  1. Install core in filter dryers after leak test but before evacuation.
  2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
  3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  4. Charge system with a new filter-dryer core in charging line.

### 3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
  1. Open shutoff valves in condenser water circuit.
  2. Verify that compressor oil level is correct.
  3. Open compressor suction and discharge valves.
  4. Open refrigerant valves except bypass valves that are used for other purposes.
  5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

## SECTION 232500 - HVAC WATER TREATMENT

## 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 water treatment systems for the followings:
  - 1. Closed hydronic systems, hot-water heating.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Maintain water quality for HVAC systems that controls corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without posing a hazard to operating personnel or the environment.
- B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

## 1.4 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
  - 1. Bypass feeders.
  - 2. Chemical material safety data sheets.
- B. Field quality-control test reports.
- C. Other Informational Submittals:
  - 1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
  - 2. Water Analysis: Illustrate water quality available at Project site.

## 1.5 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.



## 1.6 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for closed loop systems. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:
1. Initial water analysis and HVAC water-treatment recommendations.
  2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
  3. Periodic field service and consultation.
  4. Customer report charts and log sheets.
  5. Laboratory technical analysis.
  6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

## PART 2 - PRODUCTS

### 2.1 MANUAL CHEMICAL-FEED EQUIPMENT

- A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
1. Capacity: 2 gallon
  2. Minimum Working Pressure: 125 psig.

### 2.2 CHEMICALS

- A. Furnish chemicals recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment.
- B. System Cleaner: Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
- C. Biocide: Chlorine release agents or microbiocides.
- D. Closed-Loop Water Piping Chemicals: Sequestering agent to reduce deposits and adjust pH, corrosion inhibitors, and conductivity enhancers.

## PART 3 - EXECUTION

### 3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

### 3.2 INSTALLATION

- A. Install chemical application equipment level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Bypass Feeders: Install in closed hydronic systems, including hot-water heating and chilled water zones.
  - 1. Install bypass feeder in a bypass circuit around circulating pumps as indicated on the drawings and schematics.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 23 Section "Common Work Results for HVAC."
- D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23 Section "General Duty Valves for HVAC Piping."

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Tests and Inspections:
  - 1. Inspect field-assembled components and equipment installation.
  - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
  - 3. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
  - 4. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 5. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
  - 6. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
  - 7. Repair leaks and defects with new materials and retest piping until no leaks exist.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. At six-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis to Owner.

E. DEMONSTRATION

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION 232500

## SECTION 233113 - METAL DUCTS

## 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. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Acoustical Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

## B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.

## 1. Static-Pressure Classes:

## a. Energy Recovery Unit Ducts:

- 1) ALL Outdoor Air, Supply, Return, and Exhaust: 2-inch wg.

## b. Supply Ducts (Downstream of terminal units): 1-inch wg.

## c. Return Ducts (Fan Coil Unit Zones, Negative Pressure): 1-inch wg.

## d. General Exhaust Ducts (Negative Pressure): 1-inch wg.

## e. General Exhaust Ducts (Positive Pressure): 2-inch wg.

- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

## 1.4 SUBMITTALS

- A. Product Data: For each type of the following products:

1. Liners and adhesives.

2. Sealants and gaskets.
- B. LEED Submittals:
1. Product Data for Prerequisite EQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
  2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."
  3. Leakage Test Report for Prerequisite EA 2: Documentation of work performed for compliance with ASHRAE/IESNA 90.1-2004, Section 6.4.4.2.2 - "Duct Leakage Tests."
  4. Duct-Cleaning Test Report for Prerequisite EQ 1: Documentation of work performed for compliance with ASHRAE 62.1-2004, Section 7.2.4 - "Ventilation System Start-Up."
  5. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.
- C. Shop Drawings:
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  2. Factory- and shop-fabricated ducts and fittings.
  3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
  4. Elevation of top of ducts.
  5. Dimensions of main duct runs from building grid lines.
  6. Fittings.
  7. Reinforcement and spacing.
  8. Seam and joint construction.
  9. Penetrations through fire-rated and other partitions.
  10. Equipment installation based on equipment being used on Project.
  11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
  12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- D. Field quality-control reports.

## PART 2 - PRODUCTS

### 2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
  - 3. Finishes for Field Painting shall be prepped "Paint-Grip".
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304; cold rolled, annealed, sheet. Surface finish shall be No. 4.
- D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.4 DUCT LINER

- A. Acoustical Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

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. CertainTeed Corporation; Insulation Group.
    - b. Johns Manville (Basis of Design: Linacoustic RC)
    - c. Knauf Insulation.
    - d. Owens Corning.
  2. Maximum Thermal Conductivity:
    - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
    - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick aluminum; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
  2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  3. Butt transverse joints without gaps, and coat joint with adhesive.
  4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
  5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
  6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
  7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
  8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
    - a. Fan discharges.
    - b. Intervals of lined duct preceding unlined duct.
    - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

## 2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. VOC: Maximum 75 g/L (less water).
  - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 8. Service: Indoor or outdoor.
  - 9. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.
- C. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

## 2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction



loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install roundducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

### 3.2 SEAM AND JOINT SEALING

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.
  - 1. For static-pressure classes 1inch wg, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class C.
  - 2. For static-pressure classes 2 inch wg, and above comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class A, all traverse joints, all longitudinal seams, and all duct wall penetrations.
  - 3. For positive pressure exhaust ducts, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class A, all traverse joints, all longitudinal seams, and all duct wall penetrations.
  - 4. Install sealant materials in strict accordance with manufacturer's surface preparation and installation instructions.
  - 5. Exposed uninsulated ducts: Apply sealant NEATLY. Caulking and finish painting is of exposed ductwork is specified in Division 7 and Division 9.

### 3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.5 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.
- B. Painting of exposed ductwork including paint materials and application requirements are specified in Division 09 painting Sections. Coordinate with Architectural finishes.

### 3.6 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as follows:
  - 1. Kitchen hood grease exhaust ducts; 16 gauge welded carbon steel.
  - 2. Dishwasher hood condensate exhaust ducts; 16 gauge welded 304 stainless steel.

## B. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. Stainless-Steel Ducts: Stainless steel.

## C. Acoustical Duct Liner:

1. Acoustical Fibrous-Glass Duct Liner, 1 inch thick.
2. Provide in locations as indicated on the Drawings.

## D. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

## E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  - b. Rectangular Main to Round Branch: Conical, bellmouth..
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals."
  - a. 45-degree lateral.

END OF SECTION 233113

## SECTION 233300 - AIR DUCT ACCESSORIES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

## A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Fire dampers.
4. Flange connectors.
5. Duct silencers
6. Turning vanes.
7. Remote damper operators.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

## B. Related Sections:

1. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

## 1.3 SUBMITTALS

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

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

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

- a. Special fittings.
- b. Manual volume damper installations.
- c. Fire-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
- d. Wiring Diagrams: For power, signal, and control wiring.

- C. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

## 1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

#### 1.5 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

#### 2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- 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. Air Balance Inc.; a division of Mestek, Inc.
  - 2. American Warming and Ventilating; a division of Mestek, Inc.
  - 3. Cesco Products; a division of Mestek, Inc.
  - 4. Nailor Industries Inc.
  - 5. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.

- D. Maximum System Pressure: 2-inch wg.
- E. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners and mounting flange.
- F. Blades: Multiple single-piece blades, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Extruded vinyl, mechanically locked.
- I. Blade Axles:
  - 1. Material: Galvanized steel.
  - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Synthetic pivot bushings.
- M. Accessories:
  - 1. Adjustment device to permit setting for varying differential static pressure.
- N. Sleeve: Minimum 20-gage thickness.

### 2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
  - 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. Air Balance Inc.; a division of Mestek, Inc.
    - b. American Warming and Ventilating; a division of Mestek, Inc.
    - c. McGill AirFlow LLC.
    - d. Nailor Industries Inc.
    - e. Ruskin Company.
  - 2. Standard leakage rating, with linkage outside airstream.
  - 3. Suitable for horizontal or vertical applications.
  - 4. Frames:
    - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
    - b. Mitered and welded corners.
    - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
  - 5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.

- d. Galvanized-steel, 0.064 inch thick.
  6. Blade Axles: Galvanized steel.
  7. Bearings:
    - a. Oil-impregnated bronze.
    - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  8. Tie Bars and Brackets: Galvanized steel.
- B. Jackshaft:
1. Size: 1-inch diameter.
  2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
  2. Include center hole to suit damper operating-rod size.
  3. Include elevated platform for insulated duct mounting.

## 2.4 FIRE DAMPERS

- 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. Air Balance Inc.; a division of Mestek, Inc.
  2. Cesco Products; a division of Mestek, Inc.
  3. McGill AirFlow LLC.
  4. Nailor Industries Inc.
  5. Ruskin Company.
- B. Type: Static; rated and labeled according to UL 555 by an NRTL.
- C. Fire Rating: 1-1/2 hours.
- D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
  2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.

- G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- I. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

## 2.5 FLANGE CONNECTORS

- 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. Ductmate Industries, Inc.
  - 2. Nexus PDQ; Division of Shilco Holdings Inc.
  - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

## 2.6 DUCT SILENCERS

- 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. Commercial Acoustics.
  - 2. Industrial Acoustics Company. (Basis of Design).
  - 3. Industrial Noise Control, Inc.
  - 4. McGill AirFlow LLC.
  - 5. Ruskin Company.
  - 6. Vibro-Acoustics.
- B. General Requirements:
  - 1. Performance: As scheduled on the Drawings
  - 2. Factory fabricated.
  - 3. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
  - 4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- C. Shape:
  - 1. Rectangular straight with splitters or baffles.
  - 2. Rectangular elbow with splitters or baffles.
- D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel, 0.034 inch thick.



- E. Inner Casing and Baffles: ASTM A 653/A 653M, G90 galvanized sheet metal, 0.034 inch thick, and with 1/8-inch- diameter perforations.
- F. Connection Sizes: Nominal size scheduled, provide transitions to duct sizes shown.
- G. Principal Sound-Absorbing Mechanism:
  - 1. Dissipative type with fill material.
    - a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.
    - b. Erosion Barrier: Perforated metal containments.
  - 2. Lining: Mylar
- H. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
  - 1. Lock form and seal or continuously weld joints.
  - 2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
  - 3. Reinforcement: Cross or trapeze angles for rigid suspension.
- I. Accessories:
  - 1. Factory-installed end caps to prevent contamination during shipping.
- J. Source Quality Control: Test according to ASTM E 477.
  - 1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm face velocity.
  - 2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.
- K. Capacities and Characteristics:
  - 1. See Drawings for schedule of performance.

## 2.7 TURNING VANES

- 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. Ductmate Industries, Inc.
  - 2. Duro Dyne Inc.
  - 3. METALAIRE, Inc.
  - 4. SEMCO Incorporated.
  - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vaness and Vane Runners," and 2-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall.

## 2.8 REMOTE DAMPER OPERATORS

- 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. Pottorff; a division of PCI Industries, Inc.
  - 2. Ventfabrics, Inc.
  - 3. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed, 2 inches deep.
- F. Wall-Box Cover-Plate Material: Stainless steel.

## 2.9 DUCT-MOUNTED ACCESS DOORS

- 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. American Warming and Ventilating; a division of Mestek, Inc.
  - 2. Cesco Products; a division of Mestek, Inc.
  - 3. Ductmate Industries, Inc.
  - 4. McGill AirFlow LLC.
  - 5. Nailor Industries Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
  - 1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. Vision panel.
    - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - e. Fabricate doors airtight and suitable for duct pressure class.
  - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  - 3. Number of Hinges and Locks:
    - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.

- c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
- d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

## 2.10 FLEXIBLE CONNECTORS

- 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. Ductmate Industries, Inc.
  - 2. Duro Dyne Inc.
  - 3. Ventfabrics, Inc.
  - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  - 1. Minimum Weight: 26 oz./sq. yd..
  - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
  - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  - 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

## 2.11 FLEXIBLE DUCTS

- 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. Flexmaster U.S.A., Inc.
  - 2. McGill AirFlow LLC.
  - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 10 to plus 160 deg F.
- C. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 10 to plus 160 deg F.
- D. Flexible Duct Connectors:
  - 1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

## 2.12 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install firedampers according to UL listing.

- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Downstream from manual volume dampers, control dampers, and equipment.
  - 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 4. At each change in direction and at maximum 50-foot spacing.
  - 5. Upstream of turning vanes.
  - 6. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
  - 1. Two-Hand Access: 12 by 6 inches.
- K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers to low-pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands.
- P. Install duct test holes where required for testing and balancing purposes.
- Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

### 3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Operate dampers to verify full range of movement.
  - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
  - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  - 4. Inspect turning vanes for proper and secure installation.
  - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

## SECTION 233423 - HVAC POWER VENTILATORS

## 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. Centrifugal roof ventilators.
  2. Ceiling-mounted ventilators.
  3. In-line centrifugal fans.
  4. Propeller fans.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on sea level.
- B. Operating Limits: Classify according to AMCA 99.
- C. Capacities and Characteristics: As Scheduled on the Drawings.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
  1. Certified fan performance curves with system operating conditions indicated.
  2. Certified fan sound-power ratings.
  3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  4. Material thickness and finishes, including color charts.
  5. Dampers, including housings, linkages, and operators.
  6. Roof curbs.
  7. Fan speed controllers.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  2. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For power ventilators 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, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards:
  - 1. Power ventilators shall comply with UL 705.
  - 2. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

### 1.6 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

### 1.7 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. Belts: One set(s) for each belt-driven unit.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Acme Engineering & Manufacturing Corporation.
  - 2. Captive-Aire.
  - 3. Greenheck Fan Corporation.
  - 4. Loren Cook Company.

### 2.2 CENTRIFUGAL ROOF VENTILATORS

- A. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
  - 1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector (as scheduled).
  - 2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance (as scheduled).
- B. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

- C. Belt Drives:
  - 1. Resiliently mounted to housing.
  - 2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
  - 3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
  - 4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
  - 5. Fan and motor isolated from exhaust airstream.
  
- D. Accessories: As Scheduled on the Drawings.
  - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside or outside fan housing, factory wired through an internal aluminum conduit.
  - 3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
  - 4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
  - 5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
  
- E. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
  - 1. Configuration: Self-flashing without a cant strip, with mounting flange.
  - 2. Overall Height: 24 inches.
  - 3. Pitch Mounting: Manufacture curb for roof slope.
  - 4. Vented Curb: Unlined with louvered vents in vertical sides.
  
- F. Capacities and Characteristics: As Scheduled on the Drawings.

### 2.3 CEILING-MOUNTED VENTILATORS

- A. Housing: Steel, lined with acoustical insulation.
  
- B. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
  
- C. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.
  
- D. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
  
- E. Accessories: As Scheduled on the Drawings.
  - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
  - 3. Isolation: Rubber-in-shear vibration isolators.
  - 4. Manufacturer's standard roof jack or wall cap, and transition fittings.
  
- F. Capacities and Characteristics: As Scheduled on the Drawings.



## 2.4 IN-LINE CENTRIFUGAL FANS

- A. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- B. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- C. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- D. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- E. Accessories: As Scheduled on the Drawings.
  - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 2. Companion Flanges: For inlet and outlet duct connections.
  - 3. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
  - 4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
  - 5. Vibration Isolators: Type: Spring and elastomeric hangers.
- F. Capacities and Characteristics: As Scheduled on the Drawings.

## 2.5 PROPELLER FANS

- A. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.
- B. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.
- C. Fan Drive: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- D. Fan Drive:
  - 1. Resiliently mounted to housing.
  - 2. Statically and dynamically balanced.
  - 3. Selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
  - 4. Extend grease fitting to accessible location outside of unit.
  - 5. Service Factor Based on Fan Motor Size: 1.4.
  - 6. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
  - 7. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
    - a. Ball-Bearing Rating Life: ABMA 9, L<sub>10</sub> of 100,000 hours.
  - 8. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
  - 9. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
  - 10. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
  - 11. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

- E. Accessories: As Scheduled on the Drawings.
  - 1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings.
  - 2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
  - 3. Wall Sleeve: Galvanized steel to match fan and accessory size.
  - 4. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 5. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
- F. Capacities and Characteristics: As Scheduled on the Drawings.

## 2.6 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
- B. Enclosure Type: Totally enclosed, fan cooled.

## 2.7 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Install kitchen exhaust fans and systems according to NFPA 96.
- C. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Division 07 Section "Roof Accessories" for installation of roof curbs.
- E. Install units with clearances for service and maintenance.

- F. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

### 3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  - 3. Verify that cleaning and adjusting are complete.
  - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  - 5. Adjust belt tension.
  - 6. Adjust damper linkages for proper damper operation.
  - 7. Verify lubrication for bearings and other moving parts.
  - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
  - 10. Shut unit down and reconnect automatic temperature-control operators.
  - 11. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

### 3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

- B. Adjust belt tension.
- C. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION 233423

## SECTION 233600 - AIR TERMINAL UNITS

## 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. Fan-powered air terminal units.
  - 2. Shutoff, single-duct air terminal units.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

## 1.4 SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
  - 1. Air terminal units.
  - 2. Liners and adhesives.
  - 3. Sealants and gaskets.
- B. LEED Submittal:
  - 1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
- C. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Instructions for resetting minimum and maximum air volumes.
  - 2. Instructions for adjusting software set points.

## 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.

- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

## PART 2 - PRODUCTS

### 2.1 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Anemostat Products; a Mestek Company.
  2. Environmental Technologies, Inc.
  3. Krueger.
  4. METALAIRE, Inc.
  5. Nailor Industries Inc.
  6. Price Industries.
  7. Titus.
  8. Trane; a business of American Standard Companies.
  9. Tuttle & Bailey.
- B. Performance: As Scheduled on the Drawings.
- C. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- D. Casing: 0.034-inch steel, single wall.
1. Casing Lining: Adhesive attached, 1/2-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
    - a. Cover liner with nonporous foil.
  2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
  3. Air Outlet: S-slip and drive connections, size matching inlet size.
  4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
  5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- E. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.
  2. Damper Position: Normally open.
- F. Attenuator Section: 0.034-inch steel sheet.
1. Lining: Adhesive attached, 1/2-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
    - a. Cover liner with nonporous foil.

2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- G. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- H. Direct Digital Controls: Single-package unitary controller and actuator specified in Division 23 Section "Instrumentation and Control for HVAC."

## 2.2 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- C. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  1. Where practical, install concrete inserts before placing concrete.
  2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."
- C. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

### 3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

### 3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
  - 3. Verify that controls and control enclosure are accessible.
  - 4. Verify that control connections are complete.
  - 5. Verify that nameplate and identification tag are visible.
  - 6. Verify that controls respond to inputs as specified.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600



## SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

## 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. Diffusers, Registers, and Grilles.
- B. Related Sections:
  - 1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Source quality-control reports.

## PART 2 - PRODUCTS

## 2.1 DIFFUSERS, REGISTERS AND GRILLES

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Anemostat Products; a Mestek company.
  - b. METALAIRE, Inc.
  - c. Price Industries.
  - d. Titus.
- 2. Material: As Scheduled on the Drawings.
- 3. Finish: As Scheduled on the Drawings.
- 4. Face Style: As Scheduled on the Drawings.
- 5. Mounting: As Scheduled on the Drawings.
- 6. Pattern: As Scheduled on the Drawings.
- 7. Dampers: As Scheduled on the Drawings.
- 8. Accessories: As Scheduled on the Drawings.

## 2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

## SECTION 233723 - HVAC GRAVITY VENTILATORS &amp; WALL LOUVERS

## 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 types of wall louvers, roof-mounting intake and relief ventilators:
  - 1. Roof hoods.
  - 2. Wall louvers.
- B. Related Sections include the following:
  - 1. Division 4 Section "Masonry."
  - 2. Division 7 Section "Roofing."
  - 3. Division 23 Section "HVAC Power Ventilators" for roof-mounting exhaust fans.
  - 4. Division 23 Section "Instrumentation and Control for HVAC systems" for motor operated dampers.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
  - 2. Performance data indicating; free area, flow, pressure drop, water penetration curves, specific to each scheduled roof hood and louver.
  - 3. Finish and color charts for roof hoods and louvers.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Intake and relief ventilators shall be capable of withstanding the effects of gravity loads, wind loads, seismic loads, and thermal movements without permanent deformation of components, noise or metal fatigue, or permanent damage to fasteners and anchors.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain ventilators through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

- B. Product Options: Drawings, schedules, and elevations indicate size, profiles, and dimensional requirements of louvers and intake and relief ventilators and are based on the specific equipment indicated. Refer to Division 1 Section "Product Requirements."
  - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

## 1.6 COORDINATION

- A. Coordinate installation of roof curbs and roof penetrations with Division 7 Section "Roofing."
- B. Coordinate installation of louvers and wall penetrations with Division 4 Section "Masonry" and Division 7.

## 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.

### 2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.
- D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
  - 1. Use types and sizes to suit unit installation conditions.
  - 2. Use hex-head or Phillips pan-head screws for exposed fasteners, unless otherwise indicated.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

### 2.3 FABRICATION, GENERAL

- A. Factory fabricate intake and relief ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

#### 2.4 VENTILATOR HOODS

- A. Manufacturers:
  - 1. Acme.
  - 2. Greenheck.
  - 3. Loren Cook Company.
- B. Factory fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 5-6 and 5-7.
- C. Materials: Galvanized-steel sheet, minimum 0.064-inch- thick base and 0.040-inch- thick hood or aluminum sheet, minimum 0.063-inch- thick base and 0.050-inch- thick hood; suitably reinforced.
- D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening, roof slope, and ventilator base.
- E. Bird Screening: Galvanized-steel, 1/2-inch- square mesh, 0.041-inch wire Aluminum, 1/2-inch- square mesh, 0.063-inch wire.
- F. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.
- G. Aluminum Finishes:
  - 1. ASTM-D-3363-74, Kynar 500/HYLAR 5000.
  - 2. Color: As selected by Architect from the full range of industry colors and color densities.

#### 2.5 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Manufacturers:
  - 1. American Warming & Ventilating Company
  - 2. Greenheck.
  - 3. Ruskin.
- B. Horizontal, Drainable-Blade Louver as scheduled on drawings.
  - 1. Louver Depth: 6 inches.
  - 2. Frame and Blade Nominal Thickness: As required to comply with structural performance requirements, but not less than 0.080 inch.
  - 3. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- C. Louver Screens

1. General: Provide screen at each exterior louver.
  - a. Screen Location for Fixed Louvers: Interior face.
  - b. Screening Type: Bird screening, unless otherwise indicated; insect screening where indicated.
  - c. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- D. Louver Screening for Aluminum Louvers:
  1. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.
- E. Aluminum Finishes:
  1. ASTM-D-3363-74, Kynar 500/HYLAR 5000.
  2. Color: As selected by Architect from the full range of industry colors and color densities.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install louvers and intake and relief ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Install louvers in strict accordance with manufacturer's requirements and as detailed on the drawings; with duct plenum pitched to exterior, sealed joints, and with access doors.
- C. Secure intake and relief ventilators to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible. Refer to Division 7 Section "Roof Accessories" for installation of roof curbs.
- D. Install intake and relief ventilators with clearances for service and maintenance.
- E. Install perimeter reveals and openings of uniform width for sealants and joint fillers.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 7 Section "Joint Sealants" for sealants applied during installation.
- G. Label intake and relief ventilators according to requirements specified in Division 23 Section "Mechanical Identification."
- H. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- I. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

#### 3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

END OF SECTION 233723

## SECTION 233813 - COMMERCIAL-KITCHEN HOODS

## 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 Type I commercial kitchen hoods.

## 1.3 DEFINITIONS

- A. Listed Hood: A hood, factory fabricated and tested for compliance with UL 710 by a testing agency acceptable to authorities having jurisdiction.
- B. Type I Hood: A hood designed for grease exhaust applications.

## 1.4 SUBMITTALS

- A. Product Data: For the following:

- 1. Listed hoods.
- 2. Filters/baffles.
- 3. Fire-suppression systems.
- 4. Lighting fixtures.

- B. Shop Drawings:

- 1. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.
- 2. Show cooking equipment plan and elevation to confirm minimum code-required overhang.
- 3. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
- 4. Show control cabinets.
- 5. Show fire-protection cylinders, piping, actuation devices, and manual control devices.
- 6. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 7. Wiring Diagrams: Power, signal, and control wiring.
- 8. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Include roughing-in requirements for drain connections. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.

- C. Welding certificates.

- D. Field quality-control test reports.



### 1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D 1.1M, "Structural Welding Code - Steel," for hangers and supports; and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for joint and seam welding.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

### 1.6 COORDINATION

- A. Coordinate equipment layout and installation with adjacent Work, including lighting fixtures, HVAC equipment, plumbing, and fire-suppression system components.

### 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish one (1) complete set of grease filters/baffles.

## PART 2 - PRODUCTS

### 2.1 HOOD MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 430.

Finish: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.

Finish shall be free from tool and die marks and stretch lines and shall have uniform, directionally textured, polished finish indicated, free of cross scratches. Grain shall run with long dimension of each piece.

- 1. Exposed Surfaces: ASTM A 480/A 480M, No. 4 finish (ground and polished).
- 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

- B. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Elastomeric sealant shall be NSF certified for commercial kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR, Section 177.2600, for use in areas that come in contact with food.

- 1. Color: As selected by Architect from manufacturer's full range.
- 2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.

- C. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds, and that passes testing according to UL 710.

## 2.2 GENERAL HOOD FABRICATION REQUIREMENTS

- A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.
  - 1. Welded Butt Joints: Full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.
  - 2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
  - 3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.
  - 4. Coat concealed stainless-steel welded joints with metallic-based paint to prevent corrosion.
  - 5. After zinc-coated steel is welded, clean welds and abraded areas and apply SSPC-Paint 20, high-zinc-dust-content, galvanizing repair paint to comply with ASTM A 780/A 780M.
- B. For metal butt joints, comply with SMACNA's "Kitchen Equipment Fabrication Guidelines."
- C. Where stainless steel is joined to a dissimilar metal, use stainless-steel welding material or fastening devices.
- D. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.
- E. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.
- F. In food zones, as defined in NSF, fabricate surfaces free from exposed fasteners.
- G. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.
- H. Fabricate pipe slots on equipment with turned-up edges sized to accommodate service and utility lines and mechanical connections.
- I. Fabricate enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets, unless otherwise indicated.
- J. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Equipment Fabrication Guidelines."
- K. Fabricate enclosure panels to ceiling and wall as follows:
  - 1. Fabricate panels on all exposed side(s) with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.
  - 2. Wall Offset Spacer: Minimum of 3 inches.
  - 3. Wall Shelves and Overshelves: Fabricate according to SMACNA's "Kitchen Equipment Fabrication Guidelines," with minimum 0.0625-inch- thick, stainless-steel shelf tops.

## 2.3 TYPE I EXHAUST HOOD FABRICATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Captive-Aire Systems (Basis of Design).
  2. Gaylord Industries, Inc.
  3. Grease Master; a division of Custom Industries, Inc.
  4. Greenheck.
  5. Vent Master; Div. of Garland Commercial Ranges, Ltd.
- B. Capacities and Characteristics:
1. As Scheduled on the Drawings.
- C. Weld all joints exposed to grease with continuous welds, and make filters/baffles or grease extractors and makeup air diffusers easily accessible for cleaning.
1. Fabricate hoods according to NSF 2, "Food Equipment."
  2. Hoods shall be listed and labeled, according to UL 710, by a testing agency acceptable to authorities having jurisdiction.
  3. Hoods shall be designed, fabricated, and installed according to NFPA 96.
  4. Duct Collars: Minimum least 3 inches long, continuously welded to top of hood and at corners.
- D. Hood Configuration: Exhaust and makeup air as Scheduled on the Drawings.
1. Makeup air shall be introduced through laminar-flow-type, perforated metal panels on front of hood canopy.
- E. Hood Style: Wall-mounted canopy, Single island canopy and Double-island canopy as Scheduled on the Drawings.
- F. Filters/Baffles: Removable, stainless steel. Fabricate stainless steel for filter frame and removable collection cup and pitched trough. Exposed surfaces shall be pitched to drain to collection cup. Filters/baffles shall be tested according to UL 1046, "Grease Filters for Exhaust Ducts," by an NRTL acceptable to authorities having jurisdiction.
- G. Lighting Fixtures: Surface-mounted, compact fluorescent fixtures and lamps with lenses sealed vaportight. Wiring shall be installed in conduit on hood exterior. Number and location of fixtures shall provide a minimum of 70 fc at 30 inches above finished floor.
1. Light switches shall be mounted on front panel of hood canopy in hood control panel.
  2. Lighting Fixtures: Fluorescent complying with UL 1598.
- H. Coordinate with requirements in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls " for remote monitoring.
- I. Packaged Controls:
1. Basis of Design: Captive-Aire Modulating Energy Management System (EMS).
  2. Application: Control shall be used in kitchen exhaust applications to reduce exhaust and supply air volumes while cooking appliances are idling.
  3. Controls shall be listed by ETL (UL 508A).

4. Description: Controls shall be capable of reducing exhaust and supply airflow quantities by 20% using a high/low speed control system. High and low speeds shall be adjustable by variable frequency drives. A temperature switch in the exhaust duct shall control airflow set point. A 100% airflow override button shall be supplied with an adjustable timer.
5. Control Interface: The control interface shall include (1) fan switch, (1) hood light switch, (1) 100% airflow override push button and indicator lights. Indicator lights shall include a "power" light, a "fans on" light, and a "100% air flow override" light. The control interface shall be screen printed on stainless steel and be able to be installed on the face of the hood, face of the utility cabinet, or on the face of the control enclosure.
6. Enclosure: The control enclosure shall be NEMA 1 rated and listed for installation inside of the exhaust hood utility cabinet. The control enclosure may be constructed of stainless steel.
7. Variable Frequency Drives: Variable frequency drives shall allow full adjustment of high speed and low speed airflows for proper kitchen balance. Drives shall contain motor thermal overload protection and control inputs for up to 7 preset speeds. Acceleration and deceleration times shall be fully adjustable as well as fan speed at each of the 7 different inputs. Drives shall also allow for a minimum and maximum frequency set-point.
8. Temperature Switch: Adjustable temperature switch shall be mounted in the exhaust hood riser. Temperature probe shall be constructed of stainless steel. Temperature switch shall be factory set at 130°F for 600°F cooking applications and 90°F for 400°F cooking applications. The temperature switch is normally closed and opens on temperature rise. When the switch is open, a cooking situation is detected and the fans go to high speed. When the switch is closed, an idle temperature is detected and the fans go to low speed.
9. Timer: Timer shall contain one instantaneous contact and one delayed contact. Time shall be adjustable from .05 seconds to 30 days. Timer is energized with 100% air flow override button. When button is depressed, time starts and fans go to high speed. Upon timeout, fans return to low speed or speed dictated by temperature switch.
10. Wiring and Terminal Blocks: The panels include color coded wiring with as-built wiring diagrams, and spare terminals controlled by the fire system micro switch. Factory prewired to shut down supply fans in a fire condition.

#### 2.4 WET-CHEMICAL FIRE-SUPPRESSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ansul Incorporated; a Tyco International Ltd. Company.
  2. Badger Fire Protection.
  3. Captive-Aire Systems.
  4. Kidde Fire Systems.
  5. Pyro Chem.
- B. Description: Engineered distribution piping designed for automatic detection and release or manual release of fire-suppression agent by hood operator. Fire-suppression system shall be listed and labeled for complying with NFPA 17A, "Wet Chemical Extinguishing Systems," by a qualified testing agency acceptable to authorities having jurisdiction.
  1. Steel Pipe, NPS 2 and Smaller: ASTM A 53/A 53M, Type S, Grade A, Schedule 40, plain ends.
  2. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.

3. Piping, fusible links and release mechanism, tank containing the suppression agent, and controls shall be factory installed. Controls shall be in stainless-steel control cabinet mounted on hood. Furnish manual pull station for wall mounting. Exposed piping shall be covered with chrome-plated aluminum tubing. Exposed fittings shall be chrome plated.
4. Liquid Extinguishing Agent: Noncorrosive, low-pH liquid.
5. Furnish electric-operated gas shutoff valve; refer to Division 23 Section "Facility Natural-Gas Piping."
6. Furnish electric-operated gas shutoff valve with clearly marked open and closed indicator for field installation.
7. Fire-suppression system controls shall be integrated with controls for fans, lights, and fuel supply and located in a single cabinet for each group of hoods immediately adjacent.
8. Wiring shall have color-coded, numbered terminal blocks and grounding bar. Spare terminals for fire alarm, optional wiring to start fan with fire alarm, red pilot light to indicate fan operation, and control switches shall all be factory wired in control cabinet with relays or starters. Include spare terminals for fire alarm, and wiring to start fan with fire alarm.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install hood and make connections according to NFPA 96 and manufacturers installation instructions.
- B. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, grease extractor, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.
- C. Make cutouts in hoods where required to run service lines and to make final connections, and seal openings according to UL 1978.
- D. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners, unless otherwise indicated.
- E. Install hoods to operate free from vibration.
- F. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches o.c. maximum.
- G. Install sealant in joints between equipment and abutting surfaces with continuous joint backing, unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.
- H. Install lamps, with maximum recommended wattage, in equipment with integral lighting.

- I. Set initial temperatures, and calibrate sensors.
- J. Set field-adjustable switches.

### 3.3 CONNECTIONS

- A. Make connections according to NFPA 96 and manufacturers installation instructions.
- B. Connect ducts according to requirements in Division 23 Section "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquid-tight joint.
- C. Install fire-suppression piping for remote-mounted suppression systems according to NFPA 17A, "Wet Chemical Extinguishing Systems."

### 3.4 FIELD QUALITY CONTROL

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

- 1. Tests and Inspections:
  - a. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
  - b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - c. Test gas, and liquid-carrying components for leaks. Repair or replace leaking components.
  - d. Perform hood performance tests required by authorities having jurisdiction.
  - e. Perform fire-suppression system performance tests required by authorities having jurisdiction.
- 2. Prepare test and inspection reports. Report results in writing.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial kitchen hoods. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 233813

## SECTION 235100 - BREECHINGS

## 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. Listed breechings.
- B. Related Sections include the following:
  - 1. Division 4 Section "Unit Masonry" for lined masonry chimney.

## 1.3 SUBMITTALS

- A. Product Data: For the following:
  - 1. Building-heating-appliance breeching.
- B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers, and location and size of each field connection.
  - 2. Certified Sizing Calculations for breeching and stack. Calculations shall be based on approved Boiler submittal data.
  - 3. Dimensioned Outline Drawings of Breeching: Identify and locate each appliance connection, chimney connection, breeching layout (elevation and plan views) and indicate mounting and anchorage provisions.
- C. Warranty: Special warranty specified in this Section.

## 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain listed system components through one source from a single manufacturer.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents, breechings, and stacks.
- C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

### 1.5 COORDINATION

- A. Coordinate installation of breeching and connection to masonry chimney with Division 4 Section "Unit Masonry" for lined masonry chimney.

### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within 10 years. Failures include, but are not limited to, structural failures caused by expansion and contraction.

## PART 2 - PRODUCTS

### 2.1 LISTED BUILDING-HEATING-APPLIANCE CHIMNEYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Metal Products.
  - 2. Cheminee Lining E, Inc.
  - 3. Heat-Fab, Inc.
  - 4. Metal-Fab, Inc.
  - 5. Selkirk Metalbestos.
  - 6. Van-Packer.
- B. Description: Double-wall metal vents tested according to UL 103 and rated for 1000 deg F continuously or 1400 deg F intermittent; with positive, neutral or negative flue pressure complying with NFPA 54 and NFPA 211.
- C. Construction: Inner shell and outer jacket separated by at least a 1-inch annular space filled with high-temperature, ceramic-fiber insulation, minimum density 6 pounds per cubic foot.
- D. Inner Shell: ASTM A 666, Type 304 stainless steel.
- E. Outer Jacket: Within the Building portion of the system: Galvanized steel.
- F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
  - 1. Coordinate with masonry chimney and liner installation.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2 APPLICATION

- A. Listed Building-Heating-Appliance Chimneys: Natural Gas fired Boilers.

### 3.3 INSTALLATION OF LISTED VENTS

- A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 54, NFPA 211, whichever is most stringent.
- B. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- C. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.
- D. Lap joints in direction of flow.

### 3.4 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.
- B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces. Grind welds smooth and apply touchup finish to match factory or shop finish.
- C. Provide temporary closures at ends of breechings and stacks that are not completed or connected to equipment.

END OF SECTION 235100

## SECTION 235239 - FIRE-TUBE BOILERS

## 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 packaged, factory-fabricated and -assembled boilers, trim, accessories, and integrated controls for generating hot water with the following configurations and burners:
  - 1. Horizontal, fire-tube boilers.
  - 2. Combination gas and oil burners.
  - 3. Operating controls.

## 1.3 SUBMITTALS

- A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Source quality-control test reports.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For boilers, components, and accessories to include in emergency, operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.
- G. Other Informational Submittals:
  - 1. Startup service reports.

## 1.4 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. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

- C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- D. UL Compliance: Test Boilers for compliance with UL 726, "Oil-Fired Boiler Assemblies" and UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

#### 1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace front- and rear-door refractories and heat exchangers of boilers that fail in materials or workmanship within specified warranty period.
  - 1. Horizontal, Fire-Tube Boilers: Refractory in front and rear doors, 10 years from date of startup by factory-authorized personnel.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cleaver-Brooks (Basis of Design).
  - 2. Hurst Boiler & Welding Company, Inc.
  - 3. Superior Boiler Works, Inc.

#### 2.2 MANUFACTURED UNITS

- A. Performance and Characteristics: As Scheduled on the Drawings.
  - 1. Maximum design pressure rating: 125 psig.
  - 2. Maximum water temperature: 200 degrees F.
  - 3. Maximum system temperature drop: 30 degrees F.
- B. Description: Factory-fabricated, -assembled, and -tested, horizontal, fire-tube boilers with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket, flue-gas vent, water supply and return connections, and controls.
- C. Pressure Vessel Design: Straight, steel tubes welded into steel headers. Four passes with dry-back design. Minimum heat-exchanger surface of 5 sq. ft./bhp. Include the following accessories:
  - 1. Handholes for water-side inspections.
  - 2. Lifting lugs on top of boiler.
  - 3. Minimum NPS 1 hose-end drain valves at shell low point.
  - 4. Tappings or flanges for supply- and return-water piping.

5. Built-in air separator.

D. Front and Rear Doors:

1. Davited, sealed with heat-resistant gaskets and fastened with lugs and cap screws.
2. Designed so tube sheets and flues are fully accessible for inspection or cleaning when doors are open.
3. Include observation ports in doors at both ends of boiler for inspection of flame conditions.
4. Door refractory insulation shall be accessible for inspection and maintenance.

E. Casing:

1. Insulation: Minimum 2-inch- thick, mineral-fiber insulation surrounding the boiler shell.
2. Flue Connection: Flange at top of boiler.
3. Jacket: Galvanized sheet metal, with screw-fastened closures and baked-enamel protective finish.
4. Mounting base to secure boiler to concrete base.
5. Control Compartment Enclosure: NEMA 250, Type 1.

### 2.3 BURNER

A. Burner: Welded construction with multivane, stainless-steel, flame-retention diffuser for fuel oil and natural gas. Mount burner on hinged access door to permit access to combustion chamber.

B. Blower: Forward-curved centrifugal fan integral to burner, directly driven by motor; with adjustable, dual-blade damper assembly and locking quadrant to set air-fuel ratio.

1. Motors: Comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

C. Oil Supply: Control devices and modulating control sequence shall comply with requirements in [ASME CSD-1] [FMG] [IRI] [UL].

1. Oil Pump: Two-stage, gear-type oil pump integral to and directly driven by blower shall be capable of producing 300-psig discharge pressure and 15-inch Hg vacuum.

2. Oil Piping Specialties:

- a. Suction-line, manual, gate valve.
- b. Removable-mesh oil strainer.
- c. 0- to 30-inch Hg vacuum; 0- to 30-psig vacuum-pressure gage.
- d. 0- to 300-psig oil-nozzle pressure gage.
- e. Nozzle-line, solenoid-safety-shutoff oil valve.

D. Gas Train: Control devices and modulating control sequence shall comply with requirements in [ASME CSD-1] [FMG] [IRI] [UL].

E. Gas Pilot: Intermittent-electric-spark pilot ignition with 100 percent main-valve and pilot-safety shutoff with electronic supervision of burner flame.

F. Oil Pilot: Intermittent-electric-spark pilot ignition with 100 percent main-valve and pilot-safety shutoff solenoid with cadmium sulfide flame-safety control.

## 2.4 TRIM

- A. Include devices sized to comply with ANSI B31.9, " Building Services Piping"
- B. Aquastat Controllers: Operating, firing rate, and high limit.
- C. Safety Relief Valve: ASME rated.
- D. Pressure and Temperature Gage: Minimum 3-1/2-inch- diameter, combination water-pressure and - temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.
- E. Boiler Air Vent: Automatic.
- F. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

## 2.5 CONTROL

- A. Boiler controls shall include factory installed and programmed controller consisting of components to include operation of the following:
  - 1. Two fully modulating boilers.
  - 2. Boiler water primary circulating pumps (P-1, P-2).
  - 3. Boiler water supply temperature, flow control valves, and thermal shock protection.
  - 4. Combustion air damper and mechanical combustion air supply VFD.
  - 5. Relief air damper.
- B. Sequence of Operation: Control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At -20 deg F outside-air temperature, set supply-water temperature at 200 deg F; at 60 deg F outside-air temperature, set supply-water temperature at 140 deg F.
  - 1. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
- C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.
  - 1. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.
  - 2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual -reset type.
  - 3. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.
- D. Building Automation System Interface: Factory-install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.
  - 1. Hardwired Points:
    - a. Monitoring: On/off status, common trouble alarm, low water level alarm.
  - 2. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control

features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

## 2.6 ELECTRICAL POWER

- A. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
1. House in NEMA 250, Type 1 enclosure.
  2. Wiring shall be numbered and color-coded to match wiring diagram.
  3. Install wiring outside of an enclosure in a metal raceway.
  4. Field power interface shall be to fused disconnect switch.
  5. Provide branch power circuit to each motor and to controls circuit breaker.
  6. Provide each motor with overcurrent protection.

## 2.7 SOURCE QUALITY CONTROL

- A. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.
- B. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Examine mechanical spaces for suitable conditions where boilers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 BOILER INSTALLATION

- A. Install boilers level on concrete piers. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.
- B. Install gas-fired boilers according to NFPA 54.
- C. Install oil-fired boilers according to NFPA 31.
- D. Assemble and install boiler trim.

- E. Install electrical devices furnished with boiler but not specified to be factory mounted.
- F. Install control wiring to field-mounted electrical devices.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to boiler to allow service and maintenance.
- C. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.
- D. Connect oil piping full size to burner inlet with shutoff valve and union.
- E. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.
- F. Install piping from safety relief valves to nearest floor drain.
- G. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- H. Connect breeching full size to boiler outlet. Comply with requirements in Division 23 Section "Breechings, Chimneys, and Stacks" for venting materials.
- I. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- J. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Perform installation and startup checks according to manufacturer's written instructions.
  - 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
    - a. Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency.
    - b. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.

- c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.
- E. Performance Tests:
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
  - 2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment in order to comply.
  - 3. Perform field performance tests to determine the capacity and efficiency of boilers.
    - a. For dual-fuel boilers, perform tests for each fuel.
    - b. Test for full capacity.
    - c. Test for boiler efficiency at low fire, 50, 100 percent of full capacity. Determine efficiency at each test point.
  - 4. Repeat tests until results comply with requirements indicated.
  - 5. Provide analysis equipment required to determine performance.
  - 6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
  - 7. Notify Architect in advance of test dates.
  - 8. Document test results in a report and submit to Architect.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Train Owner's maintenance personnel to adjust, operate, and maintain boilers. Video training sessions. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 235239



## SECTION 236200 - PACKAGED COMPRESSOR AND CONDENSER UNITS

## 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 air-cooled condensing units.

## 1.3 SUBMITTALS

- A. Product Data: For each condensing unit, include rated capacities, operating characteristics, furnished specialties, and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.
- B. Shop Drawings:
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For condensing units to include in emergency, operation, and maintenance manuals.
- E. Warranty: Special warranty specified in this Section.
- F. LEED Submittal:
  - 1. Product Data for Credit EA 4: Documentation required by Credit EA 4 indicating that equipment and refrigerants comply.

## 1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of condensing units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

### 1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of equipment supports, and roof penetrations. These items are specified in Division 05 & 07.
- C. Coordinate location of piping and electrical rough-ins.

### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Compressor failure.
    - b. Condenser coil leak.
  - 2. Warranty Period: One (1) year from date of Substantial Completion.
  - 3. Warranty Period (1 to 5 Ton units, Compressor Only): Five (5) years from date of Substantial Completion.
  - 4. Warranty Period (6 to 120 Ton units, Compressor Only): One (1) year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

### 2.2 CONDENSING UNITS, AIR COOLED, 1 TO 5 TONS

- A. Manufacturers:
  - 1. Carrier Corporation; Carrier Air Conditioning Div.
  - 2. Lennox Industries Inc.
  - 3. Trane Co. (The); Worldwide Applied Systems Group.
  - 4. York International Corp.
- B. Capacities and Characteristics: As Scheduled on the Drawings.
- C. Description: Factory assembled and tested, consisting of compressor, condenser coil, fan, motors, refrigerant reservoir, and operating controls.
- D. Compressor: Scroll, hermetically sealed, with rubber vibration isolators.

1. Motor: Two speed, includes thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  2. Two-Speed Compressor: Include manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
  3. Accumulator: Suction tube.
  4. Refrigerant: R-407C or R-410A.
- E. Condenser Coil: Seamless copper-tube, aluminum-fin coil; circuited for integral liquid subcooler, with removable drain pan and brass service valves with service ports.
- F. Condenser Fan: Direct-drive, aluminum propeller fan; with permanently lubricated, totally enclosed fan motor with thermal-overload protection.
- G. Accessories:
1. Crankcase heater.
  2. Cycle Protector: Automatic-reset timer to prevent rapid compressor cycling.
  3. Filter-dryer.
  4. Liquid-line solenoid.
  5. Mounting base to provide a permanent foundation.
  6. Precharged and insulated suction and liquid tubing.
  7. Thermostatic expansion valve.
  8. Time-Delay Relay: Continues operation of evaporator fan after compressor shuts off.
- H. Unit Casing: Galvanized steel, finished with baked enamel; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.

### 2.3 CONDENSING UNITS, AIR COOLED, 6 TO 120 TONS

- A. Manufacturers:
1. Carrier Corporation; Carrier Air Conditioning Div.
  2. Lennox Industries Inc.
  3. McQuay International.
  4. Trane Co. (The); Worldwide Applied Systems Group.
  5. York International Corp.
- B. Capacities and Characteristics: As Scheduled on the Drawings.
- C. Description: Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coils, condenser fans and motors, and unit controls.
- D. Compressor: Hermetic scroll compressor designed for service with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports. Compressor mounted on rubber-in-shear vibration isolators.
1. Capacity Control: Hot-gas bypass
  2. Refrigerant: R-407C, or R-410A.
- E. Condenser Coil: Seamless copper-tube, aluminum-fin coil, including subcooling circuit and backseating liquid-line service access valve. Factory pressure test coils, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen or refrigerant.
- F. Condenser Fans: Direct-drive propeller-type vertical discharge. Include the following:

1. Permanently lubricated ball-bearing motors.
2. Separate motor for each fan.
3. Dynamically and statically balanced fan assemblies.

G. Operating and safety controls include the following:

1. Manual-reset, high-pressure cutout switches.
2. Automatic-reset, low-pressure cutout switches.
3. Low oil pressure cutout switch.
4. Compressor-winding thermostat cutout switch.
5. Compressor-overload protection.
6. Control transformer.
7. Magnetic contactors for compressor and condenser fan motors.
8. Timer to prevent excessive compressor cycling.
9. Building Automation System interface:
  - a. Factory mounted DDC controller shall support operation on a BACnet, Modbus, or LonMark network via one of the data link/physical layers as specified by the successful Building Automation Systems supplier.

H. Accessories:

1. Gage Panel: Package with refrigerant circuit suction and discharge gages.
2. Part-winding-start timing relay, circuit breakers, and contactors.
3. Sound reduction blankets for compressors.

I. Unit Casings: Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include the following:

1. Steel, galvanized or zinc coated, for exposed casing surfaces; treated and finished with manufacturer's standard paint coating.
2. Perimeter base rail with forklift slots and lifting holes to facilitate rigging.
3. Gasketed control panel door.
4. Nonfused disconnect switch, factory mounted and wired, for single external electrical power connection.
5. Condenser coil grille to protect coil from physical damage.
6. Spring isolators with 2" deflection.

## 2.4 MOTORS

A. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

## 2.5 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate condensing units according to ARI 210/240, ARI 340/360, or ARI 365.

1. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1-2004, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

- B. Test and inspect shell and tube condensers according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- C. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of condensing units.
- B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.
- C. Examine walls, floors, and roofs for suitable conditions where condensing units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.
- B. Install condensing units on concrete base. Concrete base is specified in Division 03.
- C. Install roof-mounting units on equipment supports specified in Division 05 & 07.
- D. Vibration Isolation: Mount condensing units on spring isolators. Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- E. Maintain manufacturer's recommended clearances for service and maintenance.
- F. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

#### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect refrigerant piping to air-cooled condensing units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Division 23 Section "Refrigerant Piping."

#### 3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical test and visual and mechanical inspection.
  2. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
  3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
  4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  5. Verify proper airflow over coils.
- B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- C. Remove and replace malfunctioning condensing units and retest as specified above.

### 3.5 STARTUP SERVICE

- A. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
1. Inspect for physical damage to unit casing.
  2. Verify that access doors move freely and are weathertight.
  3. Clean units and inspect for construction debris.
  4. Verify that all bolts and screws are tight.
  5. Adjust vibration isolation and flexible connections.
  6. Verify that controls are connected and operational.
- B. Lubricate bearings on fans.
- C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
- D. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.
- E. Verify proper operation of condenser capacity control device.
- F. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- G. After startup and performance test, lubricate bearings.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain condensing units.

END OF SECTION 236200

## SECTION 236423 - SCROLL WATER CHILLERS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Packaged, air-cooled, electric-motor-driven, scroll water chillers.

## 1.3 DEFINITIONS

- A. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.
- B. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.
- C. IPLV: Integrated part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.
- D. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.
- E. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

## 1.4 SUBMITTALS

- A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.
  - 1. Performance at ARI standard conditions and at conditions indicated.
  - 2. Performance at ARI standard unloading conditions.
  - 3. Minimum evaporator flow rate.
  - 4. Refrigerant capacity of water chiller.
  - 5. Oil capacity of water chiller.
  - 6. Fluid capacity of evaporator.
  - 7. Characteristics of safety relief valves.
  - 8. Minimum entering condenser-air temperature
  - 9. Performance at varying capacity with constant design entering condenser-air temperature. Repeat performance at varying capacity for different entering condenser-air temperatures from design to minimum in 10 deg F increments.

- B. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:
  - 1. Assembled unit dimensions.
  - 2. Weight and load distribution.
  - 3. Required clearances for maintenance and operation.
  - 4. Size and location of piping and wiring connections.
  - 5. Wiring Diagrams: For power, signal, and control wiring.
- C. Certificates: For certification required in "Quality Assurance" Article.
- D. Startup service reports.
- E. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.
- F. Warranty: Sample of special warranty.

#### 1.5 QUALITY ASSURANCE

- A. ARI Certification: Certify chiller according to ARI 590 certification program.
- B. ARI Rating: Rate water chiller performance according to requirements in ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."
- C. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.
- D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- E. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.
- F. Comply with NFPA 70.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within specified period.
  - 1. Compressor Warranty Period: One year from date of Substantial Completion.



## PART 2 - PRODUCTS

## 2.1 PACKAGED AIR-COOLED WATER CHILLERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
1. Carrier Corporation; a United Technologies company.
  2. McQuay International (Basis of Design).
  3. Trane.
  4. York International Corporation.
- B. Performance: As scheduled on the Drawings.
- C. Description: Factory-assembled and run-tested water chiller complete with base and frame, condenser casing, compressors, compressor motors and motor controllers, evaporator, condenser coils, condenser fans and motors, electrical power, controls, and accessories.
- D. Cabinet:
1. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
  2. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.
  3. Casing: Galvanized steel.
  4. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B 117.
  5. Sound-reduction package consisting of the following:
    - a. Acoustic enclosure around compressors.
    - b. Reduced-speed fans with acoustic treatment.
    - c. Designed to reduce sound level without affecting performance.
- E. Compressors:
1. Description: Positive-displacement direct drive with hermetically sealed casing.
  2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
  3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
  4. Capacity Control: On-off compressor cycling, plus hot-gas bypass.
  5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug, and initial oil charge.
- F. Compressor Motors:
1. Hermetically sealed and cooled by refrigerant suction gas.
  2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.
- G. Compressor Motor Controllers:
1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.
- H. Refrigeration:

1. Refrigerant: R-407C or R-410A. Classified as Safety Group A1 according to ASHRAE 34.
2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
3. Refrigerant Circuit: Each circuit shall include a thermal-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
4. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

I. Evaporator:

1. Brazed-plate or shell-and-tube design, as indicated.
2. Shell and Tube:
  - a. Description: Direct-expansion, shell-and-tube design with fluid flowing through the shell and refrigerant flowing through the tubes within the shell.
  - b. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
  - c. Shell Material: Carbon steel.
  - d. Shell Heads: Removable carbon-steel heads with multipass baffles designed to ensure positive oil return and located at each end of the tube bundle.
  - e. Shell Nozzles: Fluid nozzles located along the side of the shell and terminated with mechanical-coupling end connections for connection to field piping.
  - f. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.
3. Brazed Plate:
  - a. Direct-expansion, single-pass, brazed-plate design.
  - b. Type 316 stainless-steel construction.
  - c. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
  - d. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping.

J. Air-Cooled Condenser:

1. Plate-fin coil with integral subcooling on each circuit, rated at 450 psig.
  - a. Construct coils of copper tubes mechanically bonded to aluminum fins.
  - b. Coat coils with a baked epoxy corrosion-resistant coating after fabrication.
2. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.
3. Fan Motors: Totally enclosed nonventilating (TENV) or totally enclosed air over (TEAO) enclosure, with permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.
4. Fan Guards: Steel safety guards with corrosion-resistant coating.

K. Electrical Power:

1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.

2. House in a unit-mounted, NEMA 250, enclosure with hinged access door with lock and key or padlock and key.
3. Wiring shall be numbered and color-coded to match wiring diagram.
4. Install factory wiring outside of an enclosure in a raceway.
5. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:
  - a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
  - b. NEMA KS 1, heavy-duty, nonfusible switch.
  - c. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
6. Provide each motor with overcurrent protection.
7. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
8. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.
9. Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
  - a. Power unit-mounted controls where indicated.
  - b. Power unit-mounted, ground fault interrupt (GFI) duplex receptacle.
10. Control Relays: Auxiliary and adjustable time-delay relays.
11. Indicate the following for water chiller electrical power supply:
  - a. Current, phase to phase, for all three phases.
  - b. Voltage, phase to phase and phase to neutral for all three phases.
  - c. Three-phase real power (kilowatts).
  - d. Three-phase reactive power (kilovolt amperes reactive).
  - e. Power factor.
  - f. Running log of total power versus time (kilowatt hours).
  - g. Fault log, with time and date of each.

L. Factory Mounted Controls:

1. Stand-alone, advanced direct digital microprocessor based.
2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
3. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, backlit, liquid-crystal display or light-emitting diodes. Display the following:
  - a. Date and time.
  - b. Operating or alarm status.
  - c. Operating hours.
  - d. Outside-air temperature for chilled-water reset.
  - e. Temperature and pressure of operating set points.
  - f. Entering and leaving temperatures of chilled water.
  - g. Refrigerant pressures in evaporator and condenser.
  - h. Saturation temperature in evaporator and condenser.
  - i. No cooling load condition.
  - j. Elapsed time meter (compressor run status).
  - k. Pump status.
  - l. Anti-recycling timer status.
  - m. Percent of maximum motor amperage.
  - n. Current-limit set point.

- o. Number of compressor starts.
- 4. Control Functions:
  - a. Manual or automatic startup and shutdown time schedule.
  - b. Entering and leaving chilled-water temperatures, control set points, and motor load limit. Chilled-water leaving temperature shall be reset based on return-water temperature.
  - c. Current limit and demand limit.
  - d. External water chiller emergency stop.
  - e. Antirecycling timer.
  - f. Chilled water (evaporator) pump start digital output, starts pump when chiller is set to start.
- 5. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:
  - a. Low evaporator pressure or high condenser pressure.
  - b. Low chilled-water temperature.
  - c. Refrigerant high pressure.
  - d. High or low oil pressure.
  - e. High oil temperature.
  - f. Loss of chilled-water flow.
  - g. Control device failure.
- 6. Building Management System Interface: Factory-installed hardware and software to enable building management system to monitor, control, and display water chiller status and alarms.
  - a. Hardwired Points:
    - 1) Monitoring: On/off status, common trouble alarm.

M. Insulation:

- 1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I, for tubular materials and Type II, for sheet materials.
- 2. Thickness: 1-1/2 inches.
- 3. Factory-applied insulation over cold surfaces of water chiller components.
  - a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.
- 4. Apply protective coating to exposed surfaces of insulation.

N. Options and Accessories: As scheduled on the Drawings.

2.2 SOURCE QUALITY CONTROL

- A. Perform functional test of water chillers before shipping.
- B. Factory performance test water chillers, before shipping, according to ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."
  - 1. Allow Owner access to place where water chillers are being tested. Notify Architect 14 days in advance of testing.

- C. For water chillers located outdoors, rate sound power level according to ARI 370 procedure.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.
  - 1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 WATER CHILLER INSTALLATION

- A. Equipment Mounting: Install water chiller on concrete bases using restrained spring isolators. Comply with requirements in Division 03 Section "Cast-in-Place Concrete."
- B. Maintain manufacturer's recommended clearances for service and maintenance.
- C. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.
- D. Install separate devices furnished by manufacturer and not factory installed.

#### 3.3 CONNECTIONS

- A. Comply with requirements in Division 23 Section "Hydronic Piping" Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to chiller to allow service and maintenance.
- C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, and drain connection with valve. Make connections to water chiller with a union, flange, or mechanical coupling.

#### 3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
- C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
  - 1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.

2. Verify that pumps are installed and functional.
  3. Verify that thermometers and gages are installed.
  4. Operate water chiller for run-in period.
  5. Check bearing lubrication and oil levels.
  6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.
  7. Verify proper motor rotation.
  8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
  9. Verify and record performance of chilled-water flow and low-temperature interlocks.
  10. Verify and record performance of water chiller protection devices.
  11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- D. Prepare a written startup report that records results of tests and inspections.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers. Video record the training sessions.

END OF SECTION 236423

## SECTION 237200 - AIR-TO-AIR ENERGY RECOVERY 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. Fixed-plate total heat exchangers.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, furnished specialties, and accessories.
- B. Shop Drawings: For air-to-air energy recovery equipment. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

## 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.
- B. ARI Compliance: Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Rating Air-to-Air Energy Recovery Equipment."
- C. ASHRAE Compliance:

1. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

D. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.

E. UL Compliance: Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators".

## 1.6 COORDINATION

A. Coordinate layout and installation of air-to-air energy recovery equipment and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## 1.7 WARRANTY

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

1. Warranty Period for Fixed-Plate Total Heat Exchangers: 10 years.

## 1.8 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. Filters: One set(s) of each type of filter specified.

2. Fan Belts: One set(s) of belts for each belt-driven fan in energy recovery units.

## PART 2 - PRODUCTS

### 2.1 FIXED-PLATE TOTAL HEAT EXCHANGERS

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

1. Mitsubishi Electric Inc.

2. RenewAire LLC (Basis of Design).

3. Nu-Air.

B. Performance and Configuration: As Scheduled on the Drawings.

C. Casing: Galvanized steel.



- D. Plates: Evenly spaced and sealed and arranged for counter airflow.
  - 1. Plate Material: Chemically treated paper with selective hydroscopicity and moisture permeability, and gas barrier properties.
- E. Bypass Plenum: Within casing, with gasketed face-and-bypass dampers having operating rods extended outside casing.
- F. Supply and Exhaust Fans: Forward-curved, centrifugal fan with spring isolators and flexible duct connections.
  - 1. Motor and Drive: Belt driven with adjustable sheaves, motor mounted on adjustable base.
  - 2. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - 4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
  - 5. Spring isolators on each fan having 1-inch static deflection.
- G. Extended-Surface, Disposable Panel Filters: (Outdoor Air and Exhaust Air streams)
  - 1. Comply with NFPA 90A.
  - 2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
  - 3. Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
  - 4. Factory-fabricated, dry, extended-surface type.
  - 5. Thickness: 2 inches.
  - 6. Arrestance (ASHRAE 52.1): 90.
  - 7. Merv (ASHRAE 52.2): 8.
  - 8. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid
- H. Indoor and Wiring: Fabricate units with space within housing for piping and electrical conduits. Wire motors and controls so only single point external connections are required during installation rip.

### PART 3 - ECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install floor-mounted units on 4-inch- high concrete base.
- B. Install units with clearances for service and maintenance.
- C. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

### 3.3 CONNECTIONS

- A. Comply with requirements for ductwork specified in Division 23 Section "Metal Ducts."
- B. Install piping adjacent to machine to allow service and maintenance.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 2. Adjust seals and purge.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 4. Set initial temperature and humidity set points.
  - 5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

END OF SECTION 237200

## SECTION 237313 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

## 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. Air-handling units.

## 1.3 SUBMITTALS

- A. Product Data: For each air-handling unit indicated.

- 1. Unit dimensions and weight.
  - 2. Cabinet material, metal thickness, finishes, insulation, and accessories.
  - 3. Fans:
    - a. Certified fan-performance curves with system operating conditions indicated.
    - b. Certified fan-sound power ratings.
    - c. Fan construction and accessories.
    - d. Motor ratings, electrical characteristics, and motor accessories.
  - 4. Certified coil-performance ratings with system operating conditions indicated.
  - 5. Dampers, including housings, linkages, and operators.
  - 6. Filters with materials, sizes, quantity, and performance characteristics indicated.

- B. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

## 1.4 SOURCE QUALITY CONTROL

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.
- D. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.

- E. 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.
- F. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- G. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- H. ARI Certification: Energy recovery devices sensible and latent recovery effectiveness shall be clearly certified by the energy recovery device supplier through ARI in accordance with ARI Standard 1060.
- I. Filters: Comply with ASHRAE Standard 52.2 Minimum Efficiency Reporting Value (MERV).

## 1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes and locations of support members, if any, with actual equipment provided.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide one of the following:
  - 1. Annex Air.
  - 2. Carrier Corporation - AERO.
  - 3. McQuay - Vision (Basis of Design).
  - 4. Trane - M-Series
  - 5. York International - Solution

### 2.2 MANUFACTURED UNITS

- A. Provide units with configuration as detailed and performance as scheduled on the Drawings.
- B. Modular indoor air-handling units shall be factory assembled and consist of fans, motor and drive assembly, coils, energy recovery devices, dampers, access sections, filters, condensate pans, control devices, and accessories.

### 2.3 CABINET

- A. Materials: Formed and reinforced 2-inch double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
  - 1. Outside Casing: G90 galvanized steel.
  - 2. Inside Casing: G90 galvanized steel.
  - 3. Channel Posts: minimum 16 gauge.
  - 4. Base Rail: minimum 10 gauge.

- B. Cabinet Insulation: Comply with NFPA 90A or NFPA 90B.
  - 1. Materials: ASTM C 1071 with coated surface exposed to airstream to prevent erosion of glass fibers.
  - 2. Thickness: 2 inches.
  - 3. R-Value: Not less than R13.
  - 4. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50, when tested according to ASTM C411.
  - 5. Location and Application: Encased between outside and inside casing.
- C. Access Panels and Doors: Same materials and finishes as cabinet, complete with hinges, latches, handles, and bulb type gaskets. Inspection and access panels and doors shall be sized and located to allow periodic maintenance and inspections. Provide access panels and doors in all sections. Access doors shall be inwardly opening on positive pressure sections.
- D. Condensate Drain Pans: Formed sections of stainless-steel sheet complying with requirements in ASHRAE 62. Fabricate pans with slopes in two planes to collect condensate from cooling coils (including coil piping connections and return bends) and humidifiers when units are operating at maximum catalogued face velocity across cooling coil.
  - 1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
  - 2. Drain Connections: Both ends of pan.
  - 3. Units with stacked coils shall have an intermediate drain pan or drain trough to collect condensate from top coil.

## 2.4 FAN SECTION

- A. Type: As Scheduled on the Drawings.
- B. Fan-Section Construction: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure and equipped with formed-steel channel base for integral mounting of fan, motor, and casing panels. Mount fan with vibration isolation.
- C. Centrifugal Fan Housings: Formed- and reinforced-steel panels to make curved scroll housings with shaped cutoff, spun-metal inlet bell, and access doors or panels to allow entry to internal parts and components.
  - 1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
  - 2. Performance Class: AMCA 99-2408, Class II.
  - 3. Horizontal Flanged Split Housing: Bolted construction or bolted and welded.
- D. Plenum Fan Housings: Steel frame and panel; fabricated without fan scroll and volute housing.
- E. Fan Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower.
- F. Backward-Inclined, Centrifugal Fan Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
- G. Forward-Curved, Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.

- H. Airfoil-Fan Wheels: Steel construction with smooth-curved inlet flange, heavy backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
- I. Shafts: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
  - 1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
  - 2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- J. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
  - 1. Ball-Bearing Rating Life: ABMA L50 of 400,000 hours.
- K. Direct Drive: Factory mounted motor dynamically balanced at factory.
- L. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation and with 1.3 service factor based on fan motor.
  - 1. Sheaves: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
  - 2. Belts: Oil resistant, nonsparking, and nonstatic; matched for multiple belt drives.
  - 3. Belt Guards: Fabricate to OSHA/SMACNA requirements diamond-mesh wire screen welded to steel angle frame or equivalent; prime coated.
  - 4. Motor Mount: Adjustable for belt tensioning.
- M. Vibration Control: Install fans on spring vibration isolators having a minimum of 2-inch static deflection.
- N. Fan-Section Source Quality Control:
  - 1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
  - 2. Factory test fan performance for flow rate, pressure, power, air density, rotation speed, and efficiency. Establish ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

## 2.5 MOTORS

- A. General: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

## 2.6 COILS

- A. Coil Sections: Common or individual, insulated, galvanized-steel casings for cooling coils. Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils.
- B. Water Coils: Rated according to ARI 410 and ASHRAE 33, and bearing the ARI label.
  - 1. Piping Connections: Threaded, on same end.
  - 2. Casing: Galvanized steel.

3. Tubes: Copper.
4. Fins: Aluminum.
5. Headers: Seamless copper tube with brazed joints.
6. Source Quality Control: Test to 300 psig and to 200 psig underwater.

C. Refrigerant Coils: Rated according to ARI 410 and ASHRAE 33, and bearing the ARI label.

1. Casing: Galvanized steel.
2. Tubes: Copper.
3. Suction and Distributor: Seamless copper tube with brazed joints.
4. Fins: Aluminum.
5. Fin and Tube Joint: Mechanical bond.
6. Source Quality Control: Test to 300 psig and to 200 psig underwater.

## 2.7 ENERGY RECOVERY SECTION

A. Cabinet: Matching air handling unit cabinet construction.

B. Total Energy Wheel: Corrugated synthetic fibrous media, with desiccant intimately bound and uniformly and permanently dispersed throughout the matrix structure of the media. Desiccant material shall be a molecular sieve, 4A or smaller, to minimize cross contamination. Wheel performance must be certified with ARI Standard 1060.

C. Wheel and Cassette Support: Heavy duty reinforced galvanized structural steel.

D. Purge Sector: Unit shall be provided with a factory set, field adjustable purge sector designed to limit cross contamination at qualified design conditions to less than 0.04 percent of the exhaust air stream.

E. Drive System: The rotor drive system shall consist of a self adjusting belt around the rotor perimeter driven by an AC motor with gear reduction. The variable speed drive shall be specifically designed for heat wheel applications and include; and AC inverter, soft start/stop, rotation detection with alarm contacts, automatic self-cleaning jog cycle, and self testing capability. The speed controller shall be capable of accepting a potentiometer, VDC, or mA signal.

F. Temperature Control: The temperature control system shall consist of an integral control panel with remote sensors mounted in each of the four air streams to monitor exchanger performance. The control shall modulate rotor speed to, prevent frost build-up, reduce heat recovery for economizer mode, switch to maximum heat recovery when outdoor air temperature is higher than indoor temperature. A display keypad for monitoring and changing set-points shall be included.

## 2.8 FILTER SECTION

A. Cabinet: Modular construction matching casing defined above.

B. Media: Provide filter media with minimum MERV ratings as Scheduled on the Drawings.

C. Filter Frame: Provide filter manufacturers standard holding frames to support scheduled filter media.

D. Filter Section Gauges: Manufacturer to provide and mount mini helic gauge to read pressure drop across final filter bank. Gauge shall be Dwyer Mini Helic 2.

E. Access: Provide access doors in filter sections as required for installation, replacement and inspection. Coordinate with individual unit configurations and layouts.

## 2.9 AIRFLOW MEASURING STATION

- A. Basis of Design: Ruskin model AMS50.
- B. General: Factory installed airflow monitoring station integral with outside air control damper, airflow monitoring blades, and air straightening section. The airflow measuring station shall incorporate measuring ports in blades and shall control the amount of outside air as recommended by ASHRAE 62 and as Scheduled on the Drawings.
- C. Construction: Extruded aluminum frame and blades, synthetic jamb and blade seals, synthetic bearings, hex steel shafts, galvanized steel linkage, integral aluminum honeycomb airflow straightener.
- D. Certifications: Unit shall bear the AMCA Certified Ratings Seal – Airflow Measuring Station Performance.
- E. Provide airflow measuring stations for air handling units. Refer to Air Handler Schedules as indicated on the Drawings.

## 2.10 EXTRA MATERIALS

- A. Provide one (1) set of spare filters of each type for each unit.
- B. Provide one (1) spare belt for each fan for each unit.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Equipment Mounting: Install air-handling units on concrete housekeeping pads.
- B. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

### 3.3 CONNECTIONS



- A. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air-handling unit to allow service and maintenance.
- C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans using ASTM B 88, Type L copper tubing. Extend to nearest floor drain. Construct deep trap as detailed on the Drawings at connection to drain pan and install cleanouts at changes in direction.
- E. Hot-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- F. Refrigerant Piping: Comply with applicable requirements in Division 23 Section "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.
- G. Connect duct to air-handling units with flexible connections. Comply with requirements in Division 23 Section "Air Duct Accessories."

### 3.4 FIELD QUALITY CONTROL

- A. Inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
  - 2. Charge refrigerant coils with refrigerant and test for leaks.
  - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

### 3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Verify that shipping, blocking, and bracing are removed.
  - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
  - 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
  - 5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.

6. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
7. Comb coil fins for parallel orientation.
8. Install new, clean filters.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

### 3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

### 3.7 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

### 3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 237313

## SECTION 237339 - INDOOR, DIRECT GAS-FIRED HEATING AND VENTILATING UNITS

## 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 direct-fired H&V units.

## 1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories.
- B. LEED Submittal:
  - 1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
  - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Startup service reports.
- D. Operation and Maintenance Data: For direct-fired H&V units to include in emergency, operation, and maintenance manuals.

## 1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of direct-fired H&V units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

### 1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate with Division 23 Section "Commercial Kitchen Hoods".
- C. Coordinate with Division 23 Section "HVAC Power Ventilators".

### 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: One set for each unit.
  - 2. Fan Belts: One set for each unit.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Captive-Air Systems, Inc. (Basis of Design).
  - 2. Greenheck.
  - 3. McQuay.
  - 4. Reznor-Thomas & Betts Corporation; Mechanical Products Division.
  - 5. Sterling Gas; Mestek, Inc.
  - 6. Trane Company (The); Unitary Products Group.

### 2.2 PACKAGED UNITS

- A. Factory-assembled, prewired, self-contained unit consisting of cabinet, supply fan, controls, filters, and direct-fired gas furnace to be installed inside the building.

### 2.3 CABINET

- A. Cabinet: Single-wall galvanized-steel panels, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs.
- B. Access Panels: Lift-out for furnace and fan motor assemblies on both sides of unit.
- C. Internal Insulation: Fibrous-glass duct lining, comply with ASTM C 1071, Type II, applied on complete unit.
  - 1. Thickness: 1 inch
  - 2. Insulation Adhesive: Comply with ASTM C 916, Type I.

3. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to casing without damaging liner when applied as recommended by manufacturer and without causing air leakage.

D. Finish: Heat-resistant, baked enamel.

E. Discharge: Horizontal –pattern.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

#### 2.4 SUPPLY-AIR FAN

A. Fan Type: Centrifugal, rated according to AMCA 210; statically and dynamically balanced, galvanized steel; mounted on solid-steel shaft with heavy-duty, pillow-block bearings rated for L50 or 200,000 hours with external grease fittings.

B. Motor: Open drip proof inverter duty motor.

C. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly.

D. Mounting: Fan wheel, motor, and drives shall be mounted in fan casing with spring isolators.

#### 2.5 AIR FILTERS

A. Comply with NFPA 90A.

B. Cleanable Filters: 2-inch thick, cleanable metal mesh.

#### 2.6 DAMPERS

A. Outdoor-Air Damper: Galvanized-steel, opposed-blade dampers with vinyl blade seals and stainless-steel jamb seals, having a maximum leakage of 10 cfm/sq. ft. of damper area, at differential pressure of 2-inch wg.

B. Damper Operator: Direct coupled, electronic with spring return or fully modulating as required by the control sequence.

#### 2.7 DIRECT-FIRED GAS FURNACE

A. Description: Factory assembled, piped, and wired; and complying with ANSI Z83.4, "Direct Gas-Fired Make-Up Air Heaters"; ANSI Z83.18, "Direct Gas-Fired Industrial Air Heaters"; and NFPA 54, "National Fuel Gas Code."

B. Inside Unit External Housing: Steel cabinet with integral support inserts.

C. Burners: Cast-iron burner with stainless-steel mixing plates.

1. Control Valve: Modulating with minimum turndown ratio of 30:1.
2. Fuel: Natural gas.
3. Pilot: Electrically ignited by hot-surface ceramic igniter.

## D. Safety Controls:

1. Gas Manifold: Safety switches and controls to comply with ANSI standards.
2. Purge-Period Timer: Automatically delays burner ignition and bypasses low-limit control.
3. Airflow Proving Switch: Dual pressure switch senses correct airflow before energizing pilot and requires airflow to be maintained within minimum and maximum pressure settings across burner.
4. Manual-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
5. Gas Train: Redundant, automatic main gas valves, electric pilot valve, electronic-modulating temperature control valve, main and pilot gas regulators, main and pilot manual shutoff valves, main and pilot pressure taps, and high-low gas pressure switches.
6. Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.
7. Control Transformer: Integrally mounted 24-V ac.

## 2.8 CONTROLS

- A. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote control panel.
- B. Fan Control: Interlock fan to start with exhaust fan(s). See Division 23 Section "Sequence of Operations for HVAC Controls" for exhaust fan controls.
- C. Control Panel: Recessed within casting, with trim ring, remote panel, with engraved plastic cover, and the following lights and switches:
  1. On-off-auto switch.
  2. Supply-fan operation indicating light.
  3. Heating operation indicating light.
  4. Damper position potentiometer.
  5. Dirty-filter indicating light operated by unit-mounted differential pressure switch.
  6. Safety-lockout indicating light.
- D. Control Devices:
  1. Remote Setback Thermostat: Adjustable room thermostat with temperature readout.
  2. Static-Pressure Transmitter: Non-directional sensor with suitable range for expected input, and temperature compensated.
  3. Ionization-Type Smoke Detectors: 24-V dc, nominal; self-restoring; plug-in arrangement; integral visual-indicating light; sensitivity that can be tested and adjusted in place after installation; integral addressable module; remote controllability; responsive to both visible and invisible products of combustion; self-compensating for changes in environmental conditions.
  4. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed. Equip with filtered circuit to eliminate radio interference.
- E. Fan Control:
  1. Fan-Discharge Thermostat: Stops fan when discharge-air temperature is less than 40 deg F.
  2. Factory supplied and wired supply fan VFD controlled by field wired static pressure controller modulates supply fan to maintain space pressure setpoint.
- F. Outdoor-Air Damper Control, 100 Percent Outdoor-Air Units: Outdoor-air damper shall open when supply fan starts, and close when fan stops.
- G. Temperature Control:

1. Operates gas valve to maintain discharge-air temperature with factory-mounted sensor in fan outlet. Room override thermostat shall raise discharge-air setpoint for additional heat to maintain room temperature.
- H. DDC Interface: Stand-alone control module for link between unit controls and DDC system. Control module shall be compatible with temperature-control system specified in Division 23 Section "Instrumentation and Control for HVAC."
  1. Provide start and stop interface relay, and relay to notify DDC system alarm condition.
  2. Provide hardware interface or additional sensors as follows:
    - a. Room temperature.
    - b. Discharge-air temperature.
    - c. Furnace operating.

## 2.9 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

## 2.10 CAPACITIES AND CHARACTERISTICS

- A. As Scheduled on the Drawings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation of direct-fired H&V units.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install gas-fired units according to NFPA 54, "National Fuel Gas Code."
- B. Install floor-mounted units on isolator pads; refer to Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. Install controls and equipment shipped by manufacturer for field installation with direct-fired H&V units.

### 3.3 CONNECTIONS

- A. Piping Connections: Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to machine to allow service and maintenance.

1. Gas Piping: Comply with requirements in Division 23 Section "Facility Natural-Gas Piping." Connect gas piping with shutoff valve and union and with sufficient clearance for burner removal and service. Provide AGA-approved flexible connectors.
- B. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply ducts to direct-fired H&V units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
  1. Inspect for visible damage to furnace combustion chamber.
  2. Inspect casing insulation for integrity, moisture content, and adhesion.
  3. Verify that clearances have been provided for servicing.
  4. Verify that controls are connected and operable.
  5. Verify that filters are installed.
  6. Purge gas line.
  7. Inspect and adjust vibration isolators.
  8. Verify bearing lubrication.
  9. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
  10. Adjust fan belts to proper alignment and tension.
  11. Start unit according to manufacturer's written instructions.
  12. Complete startup sheets and attach copy with Contractor's startup report.
  13. Inspect and record performance of interlocks and protective devices; verify sequences.
  14. Operate unit for run-in period recommended by manufacturer.
  15. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:
    - a. Measure gas pressure on manifold.
    - b. Measure combustion-air temperature at inlet to combustion chamber.
    - c. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
  16. Adjust and inspect high-temperature limits.
  17. Inspect dampers, if any, for proper stroke.
  18. Inspect controls for correct sequencing of heating, mixing dampers, and normal and emergency shutdown.
  19. Measure and record airflow. Plot fan volumes on fan curve.
  20. Verify operation of remote panel, including pilot-operation and failure modes. Inspect the following:
    - a. High-limit heat.
    - b. Alarms.



21. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace malfunctioning components that do not pass tests and inspections and retest as specified above.

D. Prepare written report of the results of startup services.

### 3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

### 3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain direct-fired H&V units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 237339

## SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

## 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 split-system air-conditioning units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed mounting.

## 1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. LEED Submittals:
  - 1. Product Data for Credit EA 4: Documentation required by Credit EA 4 indicating that equipment and refrigerants comply.
  - 2. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
- C. Shop Drawings: Diagram power, signal, and control wiring.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

## 1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

- D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- F. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

#### 1.5 COORDINATION

- A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."
- B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 07 Section "Roof Accessories."

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: One set of filters for each unit.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Carrier Air Conditioning; Div. of Carrier Corporation.
  - 2. Dakin AC inc.
  - 3. Mitsubishi Electronics America, Inc.; HVAC Division.
  - 4. Sanyo Fisher (U.S.A.) Corp.
  - 5. Trane Company (The); Unitary Products Group.
  - 6. York International Corp.

#### 2.2 WALL-MOUNTING, EVAPORATOR-FAN COMPONENTS

- A. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C. Fan: Direct drive, centrifugal fan.
- D. Drain Pans: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1-2004.
- E. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- F.
- G. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
- H. Filters: Permanent, cleanable.

### 2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

- A. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - 1. Compressor Type: Reciprocating or Scroll.
  - 2. Refrigerant: R-407C or R-410A.
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
- D. Fan: Aluminum-propeller type, directly connected to motor.
- E. Motor: Permanently lubricated, with integral thermal-overload protection.
- F. Low Ambient Kit: Permits operation down to 0 deg F.
- G. Mounting Base: Polyethylene.
- H. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."

### 2.4 ACCESSORIES

- A. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
  - 1. Compressor time delay.
  - 2. 24-hour time control of system stop and start.
  - 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
  - 4. Fan-speed selection, including auto setting.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground-mounting, compressor-condenser components on 4-inch- thick, reinforced concrete base; 4 inches larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.
- D. Install roof-mounting compressor-condenser components on equipment supports specified in Division 07 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

#### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

#### 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, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

#### 3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

#### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238126

## SECTION 238213 - VALANCE HEATING UNITS

## 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. Hydronic radiant heating panels.

## 1.3 SUBMITTALS

- A. Product Data: Include rated capacities, specialties, and accessories for each product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and suspension and attachment. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

## 1.4 COORDINATION

- A. Coordinate layout and installation of radiant panels and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

## PART 2 - PRODUCTS

## 2.1 HYDRONIC RADIANT HEATING PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Sterling.
  - 2. Sun-El Corporation.
  - 3. Twa Panel Systems Inc.
- B. Performance and Configuration: As Scheduled on the Drawings.
- C. Description: Modular sheet metal panel with serpentine water piping, suitable for recessed surface mounting with frame or lay-in installation flush with T-bar ceiling grid.
  - 1. Panels: Minimum 0.0396-inch- thick, aluminum sheet.
  - 2. Backing Insulation: Minimum 1-inch- thick, mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB with factory-applied jacket.

3. Exposed-Side Panel Finish: Factory baked enamel finish.
4. Factory Piping: ASTM B 88, Type L copper tube with ASME B16.22 wrought-copper fittings and brazed joints. Piping shall be mechanically bonded to panel.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas to receive radiant heating units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for hydronic piping connections to verify actual locations before radiant heating and cooling unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install radiant heating units level and plumb.
- B. Suspend radiant heaters from structure.
- C. Support for Radiant Heating Panels in or on Grid-Type Suspended Ceilings: Use grid as a support element.
  1. Install a minimum of four ceiling support system rods or wires for each panel. Locate not more than 6 inches from panel corners.
  2. Support Clips: Fasten to panel and to ceiling grid members at or near each panel corner with clips designed for the application.
  3. Panels of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support panels independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
- D. Verify locations of thermostats with Drawings and room details before installation.

#### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Unless otherwise indicated, install shutoff valve and union or flange at each connection.
- C. Install piping adjacent to unit to allow service and maintenance.

#### 3.4 FIELD QUALITY CONTROL

- A. After installing panels, inspect unit cabinet for damage to finish. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

END OF SECTION 238213



## SECTION 238216 - AIR COILS

## 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 types of air coils that are not an integral part of air-handling units:
  - 1. Hot-water.
- B. Related Sections include the following:
  - 1. Division 23 Sections for air coils that are integral to air-handling units.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil. Include rated capacity and pressure drop for each air coil.
- B. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

## 1.4 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.

## PART 2 - PRODUCTS

## 2.1 WATER COILS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Carrier Corporation.
  - 2. Heatcraft Refrigeration Products LLC; Heat Transfer Division.
  - 3. Trane.
  - 4. McQuay
  - 5. USA Coil & Air.
  - 6. York.

- B. Performance Ratings: Tested and rated according to ARI 410 and ASHRAE 33.
- C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.
- D. Source Quality Control: Factory tested to 300 psig.
- E. Tubes: ASTM B 743 copper, minimum 0.020 inch thick.
- F. Fins: Aluminum, minimum 0.006 inch thick.
- G. Headers: Seamless copper tube with brazed joints, prime coated.
- H. Frames: Galvanized-steel channel frame, minimum 0.052 inch thick for slip-in mounting.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Straighten bent fins on air coils.
- D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

#### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to coils to allow service and maintenance.
- C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Division 23 Section "Instrumentation and Control for HVAC," and other piping specialties are specified in Division 23 Section "Hydronic Piping."

END OF SECTION 238216

## SECTION 238219 - FAN COIL UNITS

## 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 fan-coil units and accessories.

## 1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, piping packages, and accessories as specified and scheduled on the Drawings.
- B. Performance Selections: Include computer performance selections for each unit at project specific scheduled conditions.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For fan-coil units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

## 1.4 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.

## 1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fan-Coil-Unit Filters: Furnish one spare filters for each filter installed.

## PART 2 - PRODUCTS

## 2.1 DUCTED FAN-COIL UNITS

- A. 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.
1. Carrier Corporation.
  2. Environmental Technologies, Inc.
  3. Lennox Industries.
  4. McQuay International.
  5. Trane.
  6. YORK International Corporation.
- B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.
- C. Performance and Configuration: As Scheduled on the Drawings.
- D. Coil Section Insulation: 1/2-inch thick foil-faced glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
- E. Drain Pans: Insulated galvanized steel with plastic liner formed to slope from all directions to the drain connection as required by ASHRAE 62.
- F. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.
- G. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.
1. Supply-Air Plenum: Sheet metal plenum finished and insulated to match the chassis.
  2. Mixing Plenum: Sheet metal plenum finished and insulated to match the chassis with outdoor- and return-air, formed-steel dampers.
  3. Dampers: Galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.
- H. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.
- I. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.
- J. Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
1. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

- K. Factory, Hydronic Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.
  - 1. Two-way, modulating control valve for chilled-water coil.
  - 2. Two-way, modulating control valve for heating coil.
  - 3. Hose Kits: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.
    - a. Length: 24 inches.
    - b. Minimum Diameter: Equal to fan-coil-unit connection size.
  - 4. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
  - 5. Calibrated-Orifice Balancing Valves: Bronze body, ball type; 125-psig working pressure, 250 deg F maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
  - 6. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig working pressure, with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 hose-end, full-port, ball-type blowdown valve in drain connection.
  - 7. Wrought-Copper Unions: ASME B16.22.
- L. Electrical Connection: Factory wire motors and controls for a single electrical connection.
- M. DDC Terminal Unit Controller:
  - 1. Furnish and installed by HVAC Controls Contractor.
  - 2. Fan coil unit control shall be per Section 230993 Sequence of Operation.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install fan-coil units level and plumb.
- B. Install fan-coil units to comply with NFPA 90A.
- C. Verify locations of thermostats and other exposed control sensors with Drawings and room details before installation.

- D. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
  - 1. Install piping adjacent to machine to allow service and maintenance.
  - 2. Connect piping to fan-coil-units.
    - a. Factory hydronic piping package specified to be furnished with units.
      - 1) OPTION: Contractor may provide individual components of equal size, materials and quality in-lieu of factory piping package.
- B. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect 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. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan-coil units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238219

## SECTION 238239 - UNIT 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. Section Includes:
  - 1. Cabinet unit heaters with centrifugal fans and hot-water coils.
  - 2. Propeller unit heaters with hot-water coils.

## 1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Plans, elevations, sections, and details.
  - 2. Location and size of each field connection.
  - 3. Details of anchorages and attachments to structure and to supported equipment.
  - 4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
  - 5. Location and arrangement of piping valves and specialties.
  - 6. Location and arrangement of integral controls.
  - 7. Wiring Diagrams: Power, signal, and control wiring.

- C. Field quality-control test reports.

- D. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

## 1.4 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.

## 1.5 EXTRA MATERIALS

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

1. Cabinet Unit Heater Filters: Furnish one spare filter(s) for each filter installed.

## PART 2 - PRODUCTS

### 2.1 CABINET UNIT HEATERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Carrier Corporation.
  2. McQuay International.
  3. Sterling.
- B. Description: A factory-assembled and -tested unit complying with ARI 440.
- C. Performance: As Scheduled on the Drawings.
- D. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall be aluminum-foil facing to prevent erosion of glass fibers.
  1. Thickness: 1/2 inch.
  2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
  3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
  4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
- E. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
  1. Control Access Door: Key operated.
  2. Base: Minimum 0.0528-inch- thick steel, finished to match cabinet, 4 inches high with leveling bolts.
  3. Extended Piping Compartment: 8-inch- wide piping end pocket.
- F. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
  1. Glass Fiber Treated with Adhesive: 80 percent arrestance and 5 MERV.
- G. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.
- H. Fan and Motor Board: Removable.
  1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
  2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- I. Electrical Connection: Factory wire motors and controls for a single field connection.



## 2.2 PROPELLER UNIT HEATERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Carrier Corporation.
  - 2. McQuay International.
  - 3. Sterling.
- B. Description: An assembly including casing, coil, fan, and motor in vertical and horizontal discharge configuration, with adjustable discharge louvers.
- C. Performance: As Scheduled on the Drawings.
- D. Cabinet: Removable panels for maintenance access to controls.
- E. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
- F. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.
- G. General Coil Requirements: Test and rate hot-water propeller unit heater coils according to ASHRAE 33.
- H. Hot-Water Coil: Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.
- I. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- J. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Type: Permanently lubricated, variable speed.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install cabinet unit heaters to comply with NFPA 90A.
- B. Install propeller unit heaters level and plumb.

- C. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- D. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
- E. Comply with safety requirements in UL 1995.
- F. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in Division 23 Section "Hydronic Piping."
- G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 238239

## SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

## 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. Electrical equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Sleeve seals.
  - 4. Common electrical installation requirements.

## 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

## 1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

## 1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## PART 2 - PRODUCTS

## 2.1 SLEEVES FOR RACEWAYS AND CABLES

- 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.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

## 2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: Plastic. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## PART 3 - EXECUTION

### 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- F. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- G. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- H. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- I. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### 3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

## 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. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Sections include the following:
  - 1. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

## 1.3 SUBMITTALS

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

## 1.4 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. Comply with NFPA 70.

## PART 2 - PRODUCTS

## 2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alcan Products Corporation; Alcan Cable Division.
  - 2. American Insulated Wire Corp.; a Leviton Company.
  - 3. General Cable Corporation.
  - 4. Senator Wire & Cable Company.
  - 5. Southwire Company.
- B. Aluminum and Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and XHHW.

- D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC and Type SO with ground wire.

## 2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Hubbell Power Systems, Inc.
  - 3. O-Z/Gedney; EGS Electrical Group LLC.
  - 4. 3M; Electrical Products Division.
  - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- H. Portable Appliance Connections: Type SO, hard service cord to suit application.
- I. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- J. Class 2 Control Circuits: Power-limited cable, concealed in building finishes or in cable tray.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519



## SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

## 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. UTP cabling.
  - 2. RS-232 cabling.
  - 3. Low-voltage control cabling.
  - 4. Control-circuit conductors.

## 1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. IDC: Insulation displacement connector.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- D. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- E. RCDD: Registered Communications Distribution Designer.
- F. UTP: Unshielded twisted pair.

## 1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: [25] <Insert value> or less.
  - 2. Smoke-Developed Index: [50] [450] <Insert value> or less.
- B. 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.

## 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install UTP cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## PART 2 - PRODUCTS

### 2.1 PATHWAYS

- A. Support of Open Cabling: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 2. Lacing bars, spools, J-hooks, and D-rings.
  - 3. Straps and other devices.
- B. Cable Trays: Comply with requirements in Division 26 Section "Cable Trays for Electrical Systems."
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."
  - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

### 2.2 UTP CABLE

- A. Description: 100-ohm, four-pair UTP.
  - 1. Comply with ICEA S-90-661 for mechanical properties.
  - 2. Comply with TIA/EIA-568-B.1 for performance specifications.
  - 3. Comply with TIA/EIA-568-B.2, Category 6.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Communications, General Purpose: Type CM or Type CMG.
    - b. Multipurpose: Type MP or Type MPG.

### 2.3 RS-232 CABLE

- A. Standard Cable: NFPA 70, Type CM.
  - 1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
  - 2. Polypropylene insulation.
  - 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
  - 4. PVC jacket.
  - 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
  - 6. Flame Resistance: Comply with UL 1581.

### 2.4 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

## 2.5 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.
- B. Class 2 Control Circuits: Stranded copper, power-limited cable, concealed in building finishes, or power-limited tray cable, in cable tray, complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF PATHWAYS

- A. Comply with requirements in Division 26 Section "Cable Trays for Electrical Systems" for installation of cable trays.
- B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows if possible.

### 3.2 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  1. Comply with TIA/EIA-568-B.1.
  2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
  4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
  6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

E. Open-Cable Installation:

1. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Separation from EMI Sources:

1. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
2. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
3. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
4. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
5. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

### 3.3 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits, No. 22 AWG.

### 3.4 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.5 GROUNDING

- A. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Visually inspect UTP cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross connection.
- C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

END OF SECTION 260523

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL 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. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.
  - 2. Common ground bonding with lightning protection system.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
  - 1. Ground rods.
  - 2. Ground rings.
- C. Field quality-control test reports.

## 1.4 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. Comply with UL 467 for grounding and bonding materials and equipment.

## PART 2 - PRODUCTS

## 2.1 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.
3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

## 2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet long.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
1. Bury at least 24 inches below grade.
- C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
- D. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
  3. Connections to Ground Rods at Test Wells: Bolted connectors.
  4. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

### 3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including heaters, dampers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater and Heat-Tracing Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
  - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
  - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- E. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

### 3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.



- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
  - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- G. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of building.
  - 1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
  - 2. Bury ground ring not less than 24 inches from building foundation.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
  - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
  - b. Perform tests by fall-of-potential method according to IEEE 81.
- B. Report measured ground resistances that exceed the following values:
  1. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
  2. Pad-Mounted Equipment: 5 ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL 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. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.

## 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. RMC: Rigid metal conduit.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

## 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Trapeze hangers. Include Product Data for components.
  - 2. Steel slotted channel systems. Include Product Data for components.
  - 3. Equipment supports.

## 1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70.

## 1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

## PART 2 - PRODUCTS

### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
    - g. Wesanco, Inc.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

### PART 3 - EXECUTION

#### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

#### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Existing Concrete: Expansion anchor fasteners.
  5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  6. To Light Steel: Sheet metal screws.

7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
  1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

## SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL 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. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
  - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

## 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. LFMC: Liquidtight flexible metal conduit.
- D. RNC: Rigid nonmetallic conduit.

## 1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

## 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. Comply with NFPA 70.

## PART 2 - PRODUCTS

## 2.1 METAL CONDUIT AND TUBING

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

1. AFC Cable Systems, Inc.
2. Alfex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. EMT: ANSI C80.3.

D. FMC: Zinc-coated steel.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Fittings for EMT: Steel, compression type.

## 2.2 NONMETALLIC CONDUIT AND TUBING

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

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. LFNC: UL 1660.

D. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

E. Fittings for LFNC: UL 514B.

## 2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:



- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Arnco Corporation.
  - 2. Endot Industries Inc.
  - 3. IPEX Inc.
  - 4. Lamson & Sessions; Carlon Electrical Products.
- C. Description: Comply with UL 2024; flexible type, approved for riser installation.

#### 2.4 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman.
  - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type.
- E. Finish: Manufacturer's standard enamel finish.

#### 2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Thomas & Betts Corporation.
    - b. Walker Systems, Inc.; Wiremold Company (The).
    - c. Wiremold Company (The); Electrical Sales Division.

#### 2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
  - 2. EGS/Appleton Electric.
  - 3. Erickson Electrical Equipment Company.
  - 4. Hoffman.
  - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
  - 6. O-Z/Gedney; a unit of General Signal.
  - 7. RACO; a Hubbell Company.
  - 8. Robroy Industries, Inc.; Enclosure Division.
  - 9. Scott Fetzer Co.; Adalet Division.
  - 10. Spring City Electrical Manufacturing Company.

11. Thomas & Betts Corporation.
  12. Walker Systems, Inc.; Wiremold Company (The).
  13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Metal Floor Boxes: Sheet metal, fully adjustable, rectangular.
- G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  2. Nonmetallic Enclosures: Plastic.
- I. Cabinets:
1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  2. Hinged door in front cover with flush latch and concealed hinge.
  3. Key latch to match panelboards.
  4. Metal barriers to separate wiring of different systems and voltage.
  5. Accessory feet where required for freestanding equipment.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit.
  2. Concealed Conduit, Aboveground: Rigid steel conduit.
  3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed, Not Subject to Severe Physical Damage: EMT.
  3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
    - a. Mechanical rooms.
  4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

### 3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

G. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Change from NMC to rigid steel conduit before rising above the floor.

H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

I. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

J. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
  - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
  - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.

3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- K. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- L. Set metal floor boxes level and flush with finished floor surface.

### 3.3 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

## SECTION 260536 - CABLE TRAYS FOR ELECTRICAL 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. This Section includes steel cable trays and accessories.

## 1.3 SUBMITTALS

- A. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Operation and Maintenance Data: For cable trays to include in emergency, operation, and maintenance manuals.

## 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Steel, electrogalvanized cable tray shall be stored in a well-ventilated, dry location. Unpack and dry wet materials before storage.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cablofil, Inc.
  - 2. Hoffman.
  - 3. Wiremold / Legrand.

## 2.2 MATERIALS AND FINISHES

- A. Cable Tray Materials: Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture.
- B. Cable Tray Finishes:
  - 1. Finish for Carbon Steel Wire after welding and bending of mesh: Electrodeposited Zinc Plating: ASTM B 633, Type III, SC-1.
- C. Cable tray will consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat, with UL Classified splices where tray acts as Equipment Grounding Conductor (EGC).
- D. Provide splices, supports, and other fittings necessary for a complete, continuously grounded system.
  - 1. Mesh: 2 x 4 inches.
  - 2. Straight Section Lengths: 10 feet, nominal.
  - 3. Fittings: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer's instructions and other requirements of this Section.
  - 4. Cable Tray Size:
    - a. Depth: 6 inches.
    - b. Width: 12 inches.
    - c. Fill Ratio: Minimum 20% spare capacity shall be available to accommodate future cabling changes or additions.
    - d. Load Span Criteria:
      - 1) Cable tray will be capable of carrying a uniformly distributed load of 50 pounds per foot on an 8 ft support span, according to load tests of standard shown in Item A above.

## 2.3 CABLE TRAY SUPPORTS & ACCESSORIES

- A. Fittings/Supports: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer's instructions. Supports will include the manufacturer's assembly system where possible so that screws, bolts, and additional tools are not required for cable tray mounting, and tray path can adapt to installation obstacles without the need for additional parts.
  - 1. Assembly system support methods to mount from ceiling and wall structures with 1/4", 3/8" or 1/2" threaded rod, if applicable.
  - 2. Splices, including those approved for electrical continuity (bonding), as recommended by cable tray manufacturer.
  - 3. Accessories: As recommended by manufacturer to protect, support, and install cable tray system.
    - a. Divider strips, of same material and finish as cable tray.
    - b. Cable routing accessories.

- c. Support accessories.
  - d. Grounding clamp to ground cable tray.
- B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

## 2.4 EQUIPMENT GROUNDING CONDUCTOR FUNCTION & GROUNDING

- A. UL Classified cable trays may act as Equipment Grounding Conductors.
  - 1. Use UL Classified splicing methods to ensure cable tray is electrically continuous and bonded as recommended by manufacturer.
    - a. Ground cable trays at end of continuous run.
    - b. Ground continuous cable tray runs every 60 feet.
  - 2. Test cable tray system per NFPA 70B, Chapter 18 to verify grounding less than 1 ohm.
  - 3. Ground cable trays against fault current, noise, lightning, and electromagnetic interference by mounting grounding wire to each 10' cable tray section with grounding clamp.

## 2.5 WARNING SIGNS

- A. Lettering: 1-1/2-inch- high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."
- B. Materials and fastening are specified in Division 26 Section "Identification for Electrical Systems."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of cable trays. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 CABLE TRAY INSTALLATION

- A. Install cable tray level and plumb according to manufacturer's written instructions, as a complete system, including all necessary accessories.
  - 1. Cutting: Field-fabricate changes in direction & elevation by cutting & bending cable tray.
    - a. Cut cable tray wires in accordance with manufacturer's instructions.
    - b. Cable tray wires must be cut with side-action bolt cutters with offset head to ensure integrity of protective galvanic layer.
    - c. Remove burrs and sharp edges from cable trays.
- B. Fasten cable tray supports to building structure.

- C. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- D. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- E. Workspace: Install cable trays with enough space to permit access for installing cables.
- F. Install divider strips to separate cables of different systems, such as fire alarm, intercom/public address, security, and data processing.
- G. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

### 3.3 CABLE INSTALLATION

- A. Install cables only when cable tray installation has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. On vertical runs, fasten cables to tray every 18 inches. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

### 3.4 CONNECTIONS

- A. Ground cable trays according to manufacturer's written instructions.

### 3.5 PROTECTION

- A. Protect installed cable trays.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
  - 2. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

END OF SECTION 260536



## SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL 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. This Section includes the following:
  - 1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
  - 2. Handholes and boxes.
  - 3. Manholes.

## 1.3 DEFINITION

- A. RNC: Rigid nonmetallic conduit.

## 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Duct-bank materials, including separators and miscellaneous components.
  - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  - 3. Accessories for manholes, handholes, boxes.
  - 4. Warning tape.
- B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
  - 1. Duct entry provisions, including locations and duct sizes.
  - 2. Reinforcement details.
  - 3. Frame and cover design and manhole frame support rings.
  - 4. Ladder details.
  - 5. Grounding details.
  - 6. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
  - 7. Joint details.
- C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
  - 1. Duct entry provisions, including locations and duct sizes.
  - 2. Cover design.

3. Grounding details.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

#### 1.5 QUALITY ASSURANCE

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

#### 1.7 COORDINATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

### PART 2 - PRODUCTS

#### 2.1 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

#### 2.2 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Carder Concrete Products.
  2. Christy Concrete Products.
  3. Elmhurst-Chicago Stone Co.
  4. Oldcastle Precast Group.

5. Riverton Concrete Products; a division of Cretex Companies, Inc.
  6. Utility Concrete Products, LLC.
  7. Utility Vault Co.
  8. Wausau Tile, Inc.
- B. Comply with ASTM C 858 for design and manufacturing processes.
- C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
    - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
    - b. Cover Handle: Recessed.
  2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  3. Cover Legend: Molded lettering, "CABLE TV" or "TELEPHONE" as applicable for each service.
  4. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.

### 2.3 PRECAST MANHOLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Carder Concrete Products.
  2. Christy Concrete Products.
  3. Elmhurst-Chicago Stone Co.
  4. Oldcastle Precast Group.
  5. Riverton Concrete Products; a division of Cretex Companies, Inc.
  6. Utility Concrete Products, LLC.
  7. Utility Vault Co.
  8. Wausau Tile, Inc.
- B. Comply with ASTM C 858, with structural design loading as specified in Part 3 "Underground Enclosure Application" Article and with interlocking mating sections, complete with accessories, hardware, and features.
- C. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.
- D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

### 2.4 UTILITY STRUCTURE ACCESSORIES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Bilco Company (The).
  2. Campbell Foundry Company.
  3. Carder Concrete Products.

4. Christy Concrete Products.
5. East Jordan Iron Works, Inc.
6. Elmhurst-Chicago Stone Co.
7. McKinley Iron Works, Inc.
8. Neenah Foundry Company.
9. NewBasis.
10. Oldcastle Precast Group.
11. Osburn Associates, Inc.
12. Pennsylvania Insert Corporation.
13. Riverton Concrete Products; a division of Cretex Companies, Inc..
14. Strongwell Corporation; Lenoir City Division.
15. Underground Devices, Inc.
16. Utility Concrete Products, LLC.
17. Utility Vault Co.
18. Wausau Tile, Inc.

B. Manhole Frames and Covers: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; 33-inch square.
  - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
2. Cover Legend: Cast in. Selected to suit system.
  - a. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.

C. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 3/4-inch-diameter eye, and 1-by-4-inch bolt.

D. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

E. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Two required.

## 2.5 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.

## PART 3 - EXECUTION

### 3.1 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-80-PVC, in direct-buried duct bank.

- C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.
- D. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type [EPC-40] [EB-20]-PVC, in concrete-encased duct bank, unless otherwise indicated.
- E. Underground Ducts for Telephone or Cable Television Utility Service Cables: RNC, NEMA Type EPC-40-PVC, installed in direct-buried duct bank, unless otherwise indicated.
- F. Underground Ducts Crossing Paved Paths, Walks and Driveways: RNC, NEMA Type EPC-80-PVC, encased in reinforced concrete where noted.

### 3.2 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for Telephone and Cable Television Wiring:
  - 1. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
- B. Manholes: Precast concrete.
  - 1. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

### 3.3 EARTHWORK

- A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

### 3.4 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Manholes and Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
  - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
  - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
  - 3. Grout end bells into structure walls from both sides to provide watertight entrances.

- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 200-lbf-test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
  - 1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
  - 2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
    - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
  - 3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
  - 4. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
  - 5. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
  - 6. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.
- I. Direct-Buried Duct Banks:
  - 1. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving."
  - 2. Install backfill as specified in Division 31 Section "Earth Moving."

3. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Warning Tape: Bury warning tape approximately 12 inches above direct-buried ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

### 3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

#### A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

#### B. Elevations:

1. Manhole Frame: Set 1 inch above finished grade.
2. Handhole Covers: Set covers of other handholes 1 inch above finished grade.
3. Where indicated, cast handhole cover frame integrally with handhole structure.

#### C. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Division 07 Section "Bituminous Dampproofing." After ducts have been connected and grouted, and before backfilling, dampproof joints and connections and touch up abrasions and scars.

#### D. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

#### E. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

#### F. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

### 3.6 GROUNDING

#### A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

## 3.7 FIELD QUALITY CONTROL

## A. Perform the following tests and inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

## B. Correct deficiencies and retest as specified above to demonstrate compliance.

## 3.8 CLEANING

## A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

## B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543



## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL 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. Identification of power and control cables.
  - 2. Identification for conductors.
  - 3. Warning labels and signs.
  - 4. Instruction signs.
  - 5. Equipment identification labels.
  - 6. Miscellaneous identification products.

## 1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

## 1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

## 2.1 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

## 2.2 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

## 2.3 FLOOR MARKING TAPE

- A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

## 2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Metal-Backed, Butyrate Warning Signs:
  - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
  - 2. 1/4-inch grommets in corners for mounting.
  - 3. Nominal size, 10 by 14 inches.
- D. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

## 2.5 INSTRUCTION SIGNS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

## 2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

## 2.7 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black except where used for color-coding.

## 2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.
- G. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

### 3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. Power.

- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, use color-coding conductor tape to identify the phase.
1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service and feeder conductors.
    - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    - b. Colors for 208/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
    - c. Colors for 480/277-V Circuits:
      - 1) Phase A: Brown.
      - 2) Phase B: Orange.
      - 3) Phase C: Yellow.
    - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  2. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- F. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
  2. Identify system voltage with black letters on an orange background.
  3. Apply to exterior of door, cover, or other access.
  4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
- H. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

- I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
    - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
    - b. Outdoor Equipment: Stenciled legend 4 inches high.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Switchboards.
    - d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - e. Enclosed switches.
    - f. Enclosed circuit breakers.
    - g. Enclosed controllers.
    - h. Remote-controlled switches, dimmer modules, and control devices.

END OF SECTION 260553

## SECTION 260800 - COMMISSIONING OF LIGHTING AND LIGHTING CONTROL SYSTEMS

## 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 commissioning process requirements for lighting and lighting control systems, assemblies, and equipment.
- B. Related Sections:
  - 1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

## 1.3 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

## 1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.
- C. Attend testing, adjusting, and balancing review and coordination meeting.
- D. Participate in lighting and lighting control systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

### 1.5 CxA'S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual lighting and lighting control systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

### 1.6 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
  - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
  - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
  - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for lighting and lighting control systems, assemblies, equipment, and components to be verified and tested.
  - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
  - 5. Certificate of readiness certifying that lighting and lighting control systems, subsystems, equipment, and associated controls are ready for testing.
  - 6. Test and inspection reports and certificates.
  - 7. Corrective action documents.
  - 8. Verification of testing, adjusting, and balancing reports.

### 1.7 SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, prestart, and startup activities.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 TESTING PREPARATION

- A. Certify that lighting and lighting control systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that lighting and lighting control instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

- C. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- D. Inspect and verify the position of each device and interlock identified on checklists.
- E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

### 3.2 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of lighting system controllers and sensors.
- C. The CxA along with the electrical Subcontractor, and lighting consultant shall prepare detailed testing plans, procedures, and checklists for lighting and lighting control systems, subsystems, and equipment.
- D. Tests will be performed using design conditions whenever possible.
- E. The CxA may direct that set points be altered when simulating conditions is not practical.
- F. If tests cannot be completed because of a deficiency outside the scope of the lighting and lighting control systems, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- G. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

END OF SECTION 260800



## SECTION 260923 - LIGHTING CONTROL DEVICES

## 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 lighting control devices:
  - 1. Outdoor and indoor photoelectric switches.
  - 2. Indoor occupancy sensors.
- B. Related Sections include the following:
  - 1. Division 26 Section "Modular Dimming Controls" for dimming system equipment.
  - 2. Division 26 Section "Wiring Devices" for wall-switch vacancy sensors and manual light switches.

## 1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For each type of product 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.

## 1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

## PART 2 - PRODUCTS

## 2.1 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Area Lighting Research, Inc.; Tyco Electronics.
  2. Grasslin Controls Corporation; a GE Industrial Systems Company.
  3. Intermatic, Inc.
  4. Lithonia Lighting; Acuity Lighting Group, Inc.
  5. Novitas, Inc.
  6. Paragon Electric Co.; Invensys Climate Controls.
  7. Square D; Schneider Electric.
  8. TORK.
  9. Touch-Plate, Inc.
  10. Watt Stopper (The).
- B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
  2. Time Delay: 15-second minimum, to prevent false operation.
  3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
  4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

## 2.2 INDOOR PHOTOELECTRIC SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the products indicated on Drawings or a comparable product by one of the following:
1. Area Lighting Research, Inc.; Tyco Electronics.
  2. Eaton Electrical Inc; Cutler-Hammer Products.
  3. Grasslin Controls Corporation; a GE Industrial Systems Company.
  4. Intermatic, Inc.
  5. Lithonia Lighting; Acuity Lighting Group, Inc.
  6. MicroLite Lighting Control Systems.
  7. Novitas, Inc.
  8. Paragon Electric Co.; Invensys Climate Controls.
  9. Square D; Schneider Electric.
  10. TORK.
  11. Watt Stopper (The).
- B. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.

2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  3. Light-Level Monitoring Range: 100 to 1000 fc, with an adjustment for turn-on and turn-off levels within that range.
  4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
  5. Indicator: Two LEDs to indicate the beginning of on-off cycles.
- C. Skylight Photoelectric Sensors: Solid-state, light-level sensor; housed in a threaded, plastic fitting for mounting under skylight, facing up at skylight; with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  3. Light-Level Monitoring Range: 1000 to 10,000 fc, with an adjustment for turn-on and turn-off levels within that range.
  4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
  5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

### 2.3 INDOOR OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the products indicated on Drawings or a comparable product by one of the following:
1. Leviton Mfg. Company Inc.
  2. Lithonia Lighting; Acuity Lighting Group, Inc.
  3. Sensor Switch.
  4. Watt Stopper (The).
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  6. Bypass Switch: Override the on function in case of sensor failure.
  7. Automatic Light-Level Sensor: Adjustable from 2 to 300 fc; keep lighting off when selected lighting level is present.

- C. Dual-Technology Type: Wall- or ceiling-mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
  - 1. Sensitivity Adjustment: Separate for each sensing technology.
  - 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

## 2.4 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 16 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### 3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

#### 3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

#### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

#### 3.6 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Modular Dimming Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 260923

## SECTION 260936 – CLASSROOM LIGHTING SYSTEM

## 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 specifies an integrated classroom lighting and control system that provides:
  - 1. Single source responsibility by the manufacturer for the specified lighting fixtures, sensors, and lighting control devices in the classroom. The manufacture shall provide the following:
    - a. Lighting fixtures, lamps, motion sensors, photo-sensors, dimmer controls, power packs and relays, switches and wall cover plates, with labels, as described herein and as noted on the drawings.
    - b. Confirmation of lighting and power calculations based on the indicated design.
    - c. Wiring diagrams.
    - d. Control cables with pre-installed plug connectors.
    - e. Control Devices as indicated with receptacles for Control cables.
    - f. Installation and Owners Manuals.
    - g. Factory training for installation of products.
    - h. Single-source post-installation support for owner and their designated representatives. Pass through warranties apply for lamps, ballast, sensors and controls from the appropriate manufacturers.
- B. This Section includes the following:
  - 1. Interior lighting fixtures with lamps, ballasts and controls designed specifically for multi-functional classroom lighting.
  - 2. Accessories: As noted on the plans, provide Teacher Control Center, Single Pole Switches, Low Voltage Switches, dimmer controls, occupancy sensors, and light level photo-sensors.

## 1.3 DEFINITIONS

- A. BF: Ballast Factor. Ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.
- B. CRI: Color Rendering Index.
- C. CU: Coefficient of Utilization.
- D. LER: Luminaire Efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:

1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts

E. RCR: Room cavity ratio.

#### 1.4 SUBMITTALS

A. Product Data: For specified lighting fixtures. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including dimensions and verification of indicated parameters.
2. Certified Photometric Test Report prepared by an independent testing laboratory.
3. Fluorescent ballasts.
4. Lamps.
5. Control components: Switches, dimmers, occupancy sensors, light level sensors, relays.

B. Shop Drawings: Show details of luminaires. Indicate dimensions, weights, and method of field assembly, components, features, accessories, and location and size of each field connection.

C. Wiring Diagrams: Power, and control wiring.

1. Operation and Maintenance Data: For lighting equipment and fixtures to include: in- operation, and maintenance manuals.

D. Warranties: Special warranties specified in this Section.

#### 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: The manufacturer shall have not less than ten years experience of manufacturing pendant fluorescent luminaires.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. Source Limitations: Obtain Classroom Lighting System through one source from a single manufacturer.

#### 1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

#### 1.7 WARRANTY

A. Special Warranty for Fluorescent Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
1. Warranty Period: Two years from date of Substantial Completion.

## 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps: 1 for every 200 of each type and rating installed. Furnish at least one of each type.
  2. Parabolic Diffusers: 1 for every 500 of each type and rating installed. Furnish at least one of each type.
  3. Ballasts: 1 for every 500 of each type and rating installed. Furnish at least one of each type.
  4. Occupancy Sensors: 1 for every 200 of each type and rating installed. Furnish at least one of each type.
  5. Light Level Sensors: 1 for every 200 of each type and rating installed. Furnish at least one of each type.
  6. Dimmer Controllers: 1 for every 200 of each type and rating installed. Furnish at least one of each type.
  7. Power Pack Relays: 1 for every 200 of each type and rating installed. Furnish at least one of each type.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. The Classroom Lighting System shall consist of: pendant luminaires with specified ballast factor, lamps with specified lumen output and CRI, Teacher Control Center, Dimmer Control, faceplates with specified labels, motion control sensors, photo sensors, Relay Control Interface with Modular receptacles, Plenum-rated Low-Voltage Control cables with modular connectors, and control components.
- B. The pendant luminaires shall contain two rows of 48-inch fluorescent lamps whose primary luminous distribution is upward and one center row of 48-inch fluorescent lamps whose primary luminous distribution is downward. These rows shall be dual switched per information to follow.
- C. The control system shall consist of:
1. A Teacher Control Center (TCC) located near the teacher's primary teaching position. Teacher will select upright on or downlight on, but upright and downlight cannot be on at the same time. The cover plate for the Teacher Control Switch will be labeled "GENERAL" and "A/V MODE". Wiring from the TCC shall be through factory wired receptacle and factory supplied low-voltage cable with pre-installed connectors as described.
  2. "Quiet Time Switch". The instructor can use a toggle switch on the TCC to send a signal to the motion sensor. When the switched is toggled, the lighting in the classroom will stay on even in the absence of motion, for one hour. After one hour, the motion sensor will automatically restore to its previous state. The instructor can toggle the switch at any time to re-set "Quiet-Time" to a full 60



minute on period. While in “Quiet Time” mode the instructor will have full control of the classroom lighting. The label on the TCC will read “QUIET TIME 1 HOUR ON”.

3. Motion Sensor shall be ceiling-mounted and connect to the lighting system through low-voltage wiring using factory-installed receptacles and factory supplied cable with pre-installed connectors as described. The sensor shall turn lights on when both PIR and ultrasonic sensors detect occupancy. Once on, detection by either sensor will keep the lights on. A field adjustable time-delay shall be factory preset to recommended NEMA standards. Sensitivity settings shall adjust automatically through integrated sensor technology.
  4. The downlight of each luminaire may be dimmed to 5% of the initial light level. The TCC contains the dimmer control unit, which is labeled “A/V MODE DIMMING.”
  5. Daylight Control sensor shall be ceiling-mounted facing the primary window wall and located as shown on the drawings. It shall provide for user-adjustable light level setting between 10 and 1000 footcandles. It shall provide for an adjustable dead band setting to prevent lighting system cycling. The Daylight Control sensor shall be connected to a set of relays by plug together low voltage cables. The relays will be used to dim the uplights in each row when the sensor indicates that sufficient daylight is present. Sensor will be factory calibrated to reduce the field commissioning time to calibrate the units.
- D. The Classroom Lighting System shall be shipped from the luminaire manufacturer complete with luminare, ballasts, lamps, fixture supports, applicable control components, control cables, and device coverplates. The installer shall supply standard electrical components such as, but not limited to, electrical boxes, conduit, building wire, etc.

## 2.2 FIXTURES AND COMPONENTS, GENERAL

- A. All fixtures, ballasts, and related components not specifically mentioned below shall comply with Division 26 Section “Interior Lighting.”

## 2.3 LUMINAIRES

- A. Fixture:
1. Optical Operation:
    - a. Pendant mounted luminaire with an indirect/direct distribution using a semi-specular parabolic louver and a 91% or greater reflective center optical section to control the A/V mode of operation.
    - b. In the uplight mode, the fixture shall be at least 79% efficient with 2T8 lamps operating in the uplight mode. 70% of the light distribution shall be upward and 30% down in this mode.
    - c. In the downlight mode, the fixture shall be at least 62% efficient with 1 T8 lamp operating in the downlight mode. 10% of the light distribution shall be upward and 90% down in this mode.
  2. Voltage: 277 Volts AC.
  3. Mounting: Adjustable aircraft cable system to allow up to 48-inch suspension.
  4. Nominal Dimensions: 10 inches wide x 2 1/2 inches high in multiples of 48 inches long.
  5. Lamps: Three per cross section.
  6. Dimming Ballasts: 5% - 100% T8 electronic dimming ballasts with 0 to 10-volt dc control. Sylvania # QTP\_X32 DIM5-Q or equal (for number of lamps required).
- B. Ballasts for dimmer-controlled fixtures shall comply with general and fixture-related requirements above for electronic ballasts and the following features:

1. Dimming Range: 100 to 5% percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 25 percent of normal (93 watts reduced to 23 watts.)
3. Compatibility: Certified by manufacturer for use with specific dimming system indicated.

#### 2.4 LIGHTING CONTROL DEVICES

- A. Teacher Control Switch: SPDT switch rated for its operating voltage and current. Specification grade decorator style.
- B. Dimming Ballast Controls: Sliding-handle type with on/off control; compatible with ballast and having light output and energy input over a dimming range or 100% to 5%.
- C. Coverplates: Nylon, quantity of opens to match quantity of decorator style devices.
- D. Occupancy Sensors: Adjustable sensitivity and off delay time range of 5 to 30 minutes.
  1. Device Color: White
  2. Mounting: Ceiling-mounted.
  3. Occupancy detection indicator.
  4. Combination Sensors: Ultrasonic and infrared sensors combined.
  5. Ultrasonic Sensor: Crystal controlled with circuitry that causes no detection interference between adjacent sensors.
  6. Infrared Sensor: With daylight filter and lens to afford coverage applicable to space to be controlled.
- E. Light Level Sensor: Detect changes in ambient lighting level and provide supply for on/off control.
  1. The detection range will be between 10 and 200 foot candles
  2. The deadband will be adjustable with a 1 to 3 ratio
  3. The delay will be adjustable from 3 seconds to 5 minutes
  4. The sensor will operate via a 24-volt DC power supply and have a current draw of 22 milliamps.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Lighting fixtures:
  1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  2. Install lamps in each luminaire.
- B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
  1. Install a minimum of one ceiling support system rod or wire for each pendent support cable.
  2. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- C. Continuous Rows: Suspend from cable, brace to limit swinging as required by seismic conditions.

#### 3.2 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Ground equipment according to Division 16 Section "Grounding and Bonding."
- C. Connect wiring according to Division 16 Section "Conductors and Cables."

### 3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Verify normal operation of each fixture after installation.
- C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.
- D. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

### 3.4 STARTUP SERVICE

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

### 3.5 ADJUSTING

- A. Set field-adjustable components on Occupancy Sensors, Light Level Sensors, and Dimmer Control.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

### 3.6 CLEANING AND PROTECTION

- A. Remove and dispose of clear plastic protection from around luminaires.
- B. Clean luminaire optical surfaces.
- C. After completing installation of exposed, factory-finished luminaires, inspect exposed finishes and repair damaged finishes.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain Classroom Lighting System. Refer to Division 1.

END OF SECTION 260936

## SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

## 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 types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
  - 1. Distribution transformers.

## 1.3 SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

## 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

## 1.5 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Eaton Electrical Inc.; Cutler-Hammer Products.
  2. General Electric Company.
  3. Siemens Energy & Automation, Inc.
  4. Square D; Schneider Electric.

## 2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
1. Internal Coil Connections: Brazed or pressure type.
  2. Coil Material: Aluminum.

## 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilated, NEMA 250, Type 2.
1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Transformer Enclosure Finish: Comply with NEMA 250.
1. Finish Color: Gray.
- E. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- H. Wall Brackets: Manufacturer's standard brackets.

## 2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions.

### 3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.5 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

## SECTION 262416 - PANELBOARDS

## 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. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

## 1.3 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 6. Include wiring diagrams for power, signal, and control wiring.
- C. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

## 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. 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.
- C. Comply with NEMA PB 1.



- D. Comply with NFPA 70.

## 1.5 PROJECT CONDITIONS

- A. Environmental Limitations:
  - 1. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
    - b. Altitude: Not exceeding 6600 feet.

## 1.6 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush- and surface-mounted cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  - 3. Finishes:
    - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Same finish as panels and trim.
  - 4. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Phase, Neutral, and Ground Buses:
  - 1. Material: Tin-plated aluminum.
  - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- C. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Tin-plated aluminum.
  - 2. Main and Neutral Lugs: Compression type.

3. Ground Lugs and Bus-Configured Terminators: Compression type.
- D. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
  - E. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Square D, I-Line Series or a comparable product by one of the following:
  1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

## 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Square D, NQOD (240 V) or NF (480V) Series or comparable product by one of the following:
  1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Equipment Mounting: Install distribution panelboards on concrete bases, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
  1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
  2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  4. Install anchor bolts to elevations required for proper attachment to panelboards.
  5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Mount top of trim 72 inches above finished floor unless otherwise indicated.

- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
- F. Install filler plates in unused spaces.
- G. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into space below slab not on grade.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- I. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262416

## SECTION 262713 - ELECTRICITY METERING

## 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 equipment for electricity metering by utility company and electricity metering by Owner.

## 1.3 DEFINITIONS

- A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For electricity-metering equipment.
  - 1. Dimensioned plans and sections or elevation layouts.
  - 2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.
- C. Operation and 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 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
  - 1. Comply with requirements of utilities providing electrical power services.
  - 2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

## PART 2 - PRODUCTS

## 2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Meters will be furnished by utility company.
- B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
- C. Meter Sockets: Comply with requirements of electrical-power utility company.
- D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

## 2.2 EQUIPMENT FOR ELECTRICITY METERING BY OWNER

- A. Basis-of-Design Product: Subject to compliance with requirements, provide E-Mon D-Mon G Series or comparable product by one of the following:
  - 1. Square D; a brand of Schneider Electric.
- B. General Requirements for Owner's Meters:
  - 1. Comply with UL 1244.
  - 2. Meters used for billing shall have an accuracy complying with requirements in ANSI C12.1 and C12.16.
  - 3. Enclosure: NEMA 250, Type 1 minimum, with hasp for padlocking or sealing.
  - 4. Identification: Comply with requirements in Division 26 Section "Identification for Electrical Systems."
  - 5. Non-volatile memory.
  - 6. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
    - a. Type: Split core.
  - 7. Quantity: 6. Locations to be determined by Owner and Engineer.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

## 3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
  - 2. Turn off circuits supplied by metered feeder and secure them in off condition.
  - 3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
  - 4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
- C. Electricity metering will be considered defective if it does not pass tests and inspections.

END OF SECTION 262713



## SECTION 262726 - WIRING DEVICES

## 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. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Wall-box motion sensors.
  - 3. Snap switches.
  - 4. Wall-switch vacancy sensors.
  - 5. Cord and plug sets.
  - 6. Floor service outlets.
- B. Related Sections include the following:
  - 1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

## 1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 1. Cord and Plug Sets: Match equipment requirements.

## 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. 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 & Seymour).

### 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. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Cooper; 5351 (single), 5352 (duplex).
    - b. Hubbell; HBL5351 (single), CR5352 (duplex).
    - c. Leviton; 5891 (single), 5352 (duplex).
    - d. Pass & Seymour; 5381 (single), 5352 (duplex).

### 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.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

- a. Cooper; GF20.
- b. Pass & Seymour; 2084.

## 2.4 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
  1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
  2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## 2.5 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
  1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
    - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
    - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
    - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

## 2.6 VACANCY SENSORS

- A. Wall-Switch Sensors:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Leviton Mfg. Co., Inc., model OSSMT-MD or a comparable product by one of the following manufacturers:
    - a. Cooper.
    - b. Hubbell.
    - c. Pass & Seymour.
    - d. Watt Stopper (The).
  2. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, and a maximum coverage area of 1200 sq. ft.

## 2.7 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: Smooth, high-impact thermoplastic.

3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
  4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant thermoplastic with lockable cover.

## 2.8 FLOOR SERVICE FITTINGS

- A. Type: Modular, flap-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular, die-cast aluminum with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable.

## 2.9 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
  2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
  2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

## D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

## E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

## F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

## G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent devices under single, multigang wall plates.

## H. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

## 3.2 IDENTIFICATION

## A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use durable wire markers or tags inside outlet boxes.

## 3.3 FIELD QUALITY CONTROL

## A. Perform tests and inspections.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

## B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

## SECTION 262813 - FUSES

## 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. Cartridge fuses rated 600-V ac and less for use in enclosed switches and enclosed controllers.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components. Include the following for each fuse type indicated:
  - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  - 2. Fuse sizes for elevator feeders and elevator disconnect switches.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

## 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. 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.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.

## 1.5 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussmann, Inc.
  2. Edison Fuse, Inc.
  3. Ferraz Shawmut, Inc.
  4. Littelfuse, Inc.

## 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
1. Motor Branch Circuits: Class RK5, time delay.

## 3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

## 3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813



## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

## 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:
  - 1. Fusible switches.
  - 2. Shunt trip switches.
  - 3. Molded-case circuit breakers (MCCBs).
  - 4. Enclosures.

## 1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

## 1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

- D. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. 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.
- C. Comply with NFPA 70.

#### 1.6 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

### PART 2 - PRODUCTS

#### 2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  3. Lugs: Mechanical type, suitable for number, size, and conductor material.

#### 2.2 NONFUSIBLE SWITCHES

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  3. Lugs: Mechanical type, suitable for number, size, and conductor material.

### 2.3 SHUNT TRIP SWITCHES

- 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. Cooper Bussmann, Inc.
  2. Ferraz Shawmut, Inc.
  3. Littelfuse, Inc.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- E. Accessories:
1. Isolated neutral lug; 100 percent rating.
  2. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
  3. Form C alarm contacts that change state when switch is tripped.

### 2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
  - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
  - 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

## 2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.
  - 3. Wet or Damp, Indoor Locations: NEMA 250, Type 4.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Install fuses in fusible devices.
- C. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

## SECTION 262913 - ENCLOSED CONTROLLERS

## 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 the following enclosed controllers rated 600 V and less:
  - 1. Full-voltage manual.
  - 2. Full-voltage magnetic.

## 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

## 1.4 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
  - 1. Show tabulations of the following:
    - a. Each installed unit's type and details.
    - b. Factory-installed devices.
    - c. Nameplate legends.
    - d. Short-circuit current rating of integrated unit.
    - e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.

- f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
    - 2. Wiring Diagrams: For power, signal, and control wiring.
  - C. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
    - 1. Routine maintenance requirements for enclosed controllers and installed components.
    - 2. Manufacturer's written instructions for setting field-adjustable overload relays.
- 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.
  - B. Comply with NFPA 70.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- 1.7 COORDINATION
- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.
  3. Surface mounting.
  4. Red pilot light.
- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  2. Configuration: Nonreversing.
  3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
  4. Surface mounting.
- D. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  2. MCP Disconnecting Means:
    - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
    - d. N.O. alarm contact that operates only when MCP has tripped.

## 2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
1. Dry and Clean Indoor Locations: Type 1.
  2. Outdoor Locations: Type 3R.
  3. Wet or Damp Indoor Locations: Type 4.

## 2.3 ACCESSORIES



- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
  - 1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty, type.
    - a. Push Buttons: Recessed types; momentary as indicated.
    - b. Pilot Lights: Incandescent Resistor types; colors as indicated.
    - c. Selector Switches: Rotary type.
- B. Reversible N.C./N.O. auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- C. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- D. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- E. Comply with NECA 1.

#### 3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

### 3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
  1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
  2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
  2. Test continuity of each circuit.
- C. Tests and Inspections:
  1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
  2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
  3. Test continuity of each circuit.
  4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
  5. Test each motor for proper phase rotation.
  6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

- D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

### 3.6 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

### 3.7 PROTECTION

- A. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

### 3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913

## SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

## 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 lightning protection for structures.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminals and mounting accessories.
  - 1. Layout of the lightning protection system, along with details of the components to be used in the installation.
  - 2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.
- C. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.
- D. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.
- E. Field quality-control reports.
- F. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Certified by UL or LPI as a Master Installer/Designer, trained and approved for installation of units required for this Project.
- B. System Certificate:
  - 1. UL Master Label.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

### 1.5 COORDINATION

- A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.
- B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.
- C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

## PART 2 - PRODUCTS

### 2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. Comply with UL 96 and NFPA 780.
- B. Roof-Mounted Air Terminals: NFPA 780, Class I, aluminum or copper, as applicable for mounting location.
  - 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. Heary Bros. Lightning Protection Co. Inc.
    - b. Robbins Lightning, Inc.
    - c. Thompson Lightning Protection, Inc.
  - 2. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in Division 07 roofing Sections.
- C. Main and Bonding Conductors: Copper or Aluminum, as applicable for mounting location.
- D. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet long.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A and NFPA 780.
- B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.
- C. Conceal the following conductors:
  - 1. Down conductors.
  - 2. Conductors within normal view of exterior locations at grade within 200 feet of building.
- D. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.
  - 1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.

- E. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

### 3.2 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

### 3.3 FIELD QUALITY CONTROL

- A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.
- B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

END OF SECTION 264113

## SECTION 265100 - INTERIOR LIGHTING

## 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. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.

## B. Related Sections:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including photoelectric relays and occupancy sensors.
2. Division 26 Section "Modular Dimming Controls" for dimming system equipment.
3. Division 26 Section "Wiring Devices" for wall-box vacancy sensors.

## 1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. HID: High-intensity discharge.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.

## 1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  1. Physical description of lighting fixture including dimensions.
  2. Emergency lighting units including battery and charger.
  3. Ballast, including BF.
  4. Energy-efficiency data.
  5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.

- B. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

- 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

## 1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by either a qualified independent testing agency or manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. 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.
- C. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In Light Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
  - 1. Manufacturer/Cat. No.: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by another manufacturer.

### 2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Lamps, ballasts, and designated lighting fixtures shall be eligible for incentives under the Efficiency Maine Business Program, Prescriptive Incentives. In general, all lamps and ballasts should comply with the CEE High-Performance Commercial Lighting Systems Initiative criteria. (<http://www.cee1.org/com/com-lt/lamps-ballasts.xls>) Fixture efficiencies must meet Efficiency Maine minimum standards as noted in the Light Fixture Schedule.
- B. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, must be available for each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
  - a. Testing Agency Certified Data: Photometric data shall either be certified by a qualified independent testing agency or by manufacturer.



- b. **Manufacturer Certified Data:** Photometric data certified by a manufacturer's laboratory shall have a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- C. **Recessed Fixtures:** Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- D. **Metal Parts:** Free of burrs and sharp corners and edges.
- E. **Sheet Metal Components:** Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- F. **Doors, Frames, and Other Internal Access:** Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- G. **Diffusers:**
  - 1. **Acrylic Lighting Diffusers:** 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- H. **Factory-Applied Labels:** Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp and ballast characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
    - d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
    - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    - f. CCT and CRI for all luminaires.

### 2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. **General Requirements for Electronic Ballasts:**
  - 1. Comply with UL 935 and with ANSI C82.11.
  - 2. Designed for type and quantity of lamps served.
  - 3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
  - 4. Sound Rating: Class A.
  - 5. Total Harmonic Distortion Rating: Less than 10 percent.
  - 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
  - 7. Operating Frequency: Between 42 and 52 kHz.
  - 8. Lamp Current Crest Factor: 1.6 or less.
  - 9. BF: Between 0.85 and 1.05.
  - 10. Power Factor: 0.95 or higher.
  - 11. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

- B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts, as noted on the Light Fixture Schedule.
- C. Electronic Programmed-Start Ballasts for T8 and T5HO Lamps: Comply with ANSI C82.11 and the following:
  - 1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
  - 2. Automatic lamp starting after lamp replacement.
- D. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.
- E. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
  - 1. Dimming Range: 100 to 10 percent of rated lamp lumens.
  - 2. Ballast Input Watts: Can be reduced to 33 percent of normal or less.
  - 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
  - 4. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.
- F. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.
  - 1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
  - 2. Ballast shall provide equal current to each lamp in each operating mode.
  - 3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

#### 2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer control is indicated:
  - 1. Lamp end-of-life detection and shutdown circuit.
  - 2. Automatic lamp starting after lamp replacement.
  - 3. Sound Rating: Class A.
  - 4. Total Harmonic Distortion Rating: Less than 20 percent.
  - 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
  - 6. Operating Frequency: 20 kHz or higher.
  - 7. Lamp Current Crest Factor: 1.7 or less.
  - 8. BF: 0.95 or higher unless otherwise indicated.
  - 9. Power Factor: 0.95 or higher.

#### 2.5 BALLASTS FOR HID LAMPS

- A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features unless otherwise indicated:
  - 1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
  - 2. Minimum Starting Temperature: Minus 22 deg F for single-lamp ballasts.
  - 3. Rated Ambient Operating Temperature: 104 deg F.

4. Open-circuit operation that will not reduce average life.
5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

## 2.6 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
  2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

## 2.7 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
  1. Battery: Sealed, maintenance-free, lead-acid type.
  2. Charger: Fully automatic, solid-state type with sealed transfer relay.
  3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.8 FLUORESCENT LAMPS

- A. T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48 inches, 3100 initial lumens (minimum), CRI 82 (minimum), color temperature 3500 K, and average rated life 24,000 hours unless otherwise indicated.

- B. T8 rapid-start low-mercury lamps, rated 17 W maximum, nominal length of 24 inches, 1350 initial lumens (minimum), CRI 82 (minimum), color temperature 3500 K, and average rated life of 24,000 hours, unless otherwise indicated.
- C. T5HO rapid-start, high-output lamps, rated 54 W maximum, nominal length of 45.2 inches, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life of 20,000 hours unless otherwise indicated.
- D. Compact Fluorescent Lamps: 4-Pin, CRI 82 (minimum), color temperature 3500 K, average rated life of 12,000 hours at three hours operation per start, and suitable for use with dimming ballasts unless otherwise indicated.
  - 1. 26 W: T4, double or triple tube, rated 1800 initial lumens.
  - 2. 32 W: T4, triple tube, rated 2400 initial lumens.

## 2.9 HID LAMPS

- A. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and color temperature 4000 K.
- B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Lighting fixtures:
  - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  - 2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.
- D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
  - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
- E. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

2. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

### 3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

### 3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

END OF SECTION 265100

## SECTION 265600 - EXTERIOR LIGHTING

## 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. Exterior luminaires with lamps and ballasts.
- 2. Poles and accessories.

- B. Related Sections:

- 1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

## 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. HID: High-intensity discharge.
- D. LER: Luminaire efficacy rating.
- E. Luminaire: Complete lighting fixture, including ballast housing if provided.
- F. Pole: Luminaire support structure, including tower used for large area illumination.
- G. Standard: Same definition as "Pole" above.

## 1.4 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
  - 2. Details of attaching luminaires and accessories.
  - 3. Details of installation and construction.
  - 4. Luminaire materials.
  - 5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

- a. Photometric data shall be certified either by a qualified independent testing agency or by the manufacturer.
  - b. Photometric data certified by manufacturer's laboratory shall have a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- 6. Ballasts, including energy-efficiency data.
  - 7. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
  - 8. Materials, dimensions, and finishes of poles.
  - 9. Anchor bolts for poles.
  - 10. Manufactured pole foundations.
- B. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by either a qualified independent testing agency or manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. 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.
- C. Comply with IEEE C2, "National Electrical Safety Code."
- D. Comply with NFPA 70.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- B. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In Light Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
  - 1. Manufacturer/Cat. No.: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by another manufacturer.

### 2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, must be available for each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
  - a. Testing Agency Certified Data: Photometric data shall either be certified by a qualified independent testing agency or by manufacturer.
  - b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- H. Exposed Hardware Material: Stainless steel.
- I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- J. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- K. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- L. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- M. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole.
  - a. Color: As selected from manufacturer's standard catalog of colors.



- N. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp and ballast characteristics:
    - a. "USES ONLY" and include specific lamp type.
    - b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated).
    - c. ANSI ballast type (M98, M57, etc.).
    - d. CCT and CRI.

### 2.3 BALLASTS FOR HID LAMPS

- A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features unless otherwise indicated:
1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
  2. Minimum Starting Temperature: Minus 22 deg F.
  3. Normal Ambient Operating Temperature: 104 deg F.

### 2.4 HID LAMPS

- A. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and CCT color temperature 4000 K.

### 2.5 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

- A. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- B. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
1. Materials: Shall not cause galvanic action at contact points.
  2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
  3. Anchor-Bolt Template: Plywood or steel.
- C. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- D. Concrete Pole Foundations: Precast, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Precast Concrete."

### 2.6 STEEL POLES

- A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; one-piece construction with access handhole in pole wall.
1. Shape: Round, straight or square, straight, as noted.
  2. Mounting Provisions: Butt flange for bolted mounting on foundation.

- B. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- C. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
- D. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - a. Color: As selected from manufacturer's standard catalog of colors.

## 2.7 POLE ACCESSORIES

- A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

## PART 3 - EXECUTION

### 3.1 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Adjust luminaires that require field adjustment or aiming.

### 3.2 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
  - 1. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
  - 2. Install base covers unless otherwise indicated.
  - 3. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- C. Raise and set poles using web fabric slings (not chain or cable).

### 3.3 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 GROUNDING

- A. Ground metal poles according to Division 26 Section "Grounding and Bonding for Electrical Systems."
  - 1. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.5 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

END OF SECTION 265600

## SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

## 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. Communications equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Sleeve seals.
  - 4. Common communications installation requirements.

## 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

## 1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

## 1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## PART 2 - PRODUCTS

## 2.1 SLEEVES FOR RACEWAYS AND CABLES

- 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.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

## 2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: Plastic. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## PART 3 - EXECUTION

### 3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- F. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- G. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- H. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- I. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### 3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 270500

## SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

## 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. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks and cabinets.
4. Telecommunications service entrance pathways.
5. Grounding.

## B. Related Sections:

1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Division 27 Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.
3. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

## 1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. LAN: Local area network.
- C. RCDD: Registered Communications Distribution Designer.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Qualification Data: For installer and installation supervisor.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
- B. 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.
- C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- D. Grounding: Comply with ANSI-J-STD-607-A.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install equipment frames until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

## 1.7 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
  1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
  2. Record agreements reached in meetings and distribute them to other participants.
  3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
  4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

## PART 2 - PRODUCTS

### 2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.
  1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
  2. Support brackets with cable tie slots for fastening cable ties to brackets.
  3. Lacing bars, spools, J-hooks, and D-rings.
  4. Straps and other devices.
- C. Cable Trays: Comply with requirements for cable trays specified in Division 26 Section "Cable Trays for Electrical Systems."



## 2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

## 2.3 EQUIPMENT FRAMES

- 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. Chatsworth Products, Inc.
  - 2. Cooper B-Line, Inc.
  - 3. Hubbell, Inc.
- B. General Frame Requirements:
  - 1. Distribution Frames: Freestanding, modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
  - 2. Module Dimension: Width compatible with EIA 310 standard, 19-inch panel mounting.
  - 3. Finish: Manufacturer's standard, baked-polyester powder coat.
- C. Floor-Mounted Racks: Modular-type, aluminum construction.
  - 1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
  - 2. Baked-polyester powder coat finish.
- D. Cable Management for Equipment Frames:
  - 1. Steel, with plastic D-ring fingers.
  - 2. Baked-polyester powder coat finish.
  - 3. Vertical cable management panels shall have front and rear channels.
  - 4. Provide horizontal crossover cable managers between each pair of patch panels at each relay rack, with a minimum height of two rack units each.

## 2.4 POWER STRIPS

- A. Power Strips: Comply with UL 1363.
  - 1. Rack mounting.
  - 2. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
  - 3. LED indicator lights for power and protection status.
  - 4. LED indicator lights for reverse polarity and open outlet ground.
  - 5. Cord connected with 15-foot line cord.
  - 6. Rocker-type on-off switch, illuminated when in on position.

## 2.5 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with ANSI-J-STD-607-A.

## 2.6 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

## PART 3 - EXECUTION

### 3.1 ENTRANCE FACILITIES

- A. Install underground pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.
1. Install underground entrance pathway complying with Division 26 Section "Raceway and Boxes for Electrical Systems."

### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Cable Trays: Comply with requirements for cable trays specified in Division 26 Section "Cable Trays for Electrical Systems."
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

### 3.3 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.4 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

## SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

## 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. UTP cable.
2. 62.5/125-micrometer, optical fiber cabling.
3. Cable connecting hardware, patch panels, and cross-connects.
4. Cabling identification products.

- B. Related Sections:

1. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

## 1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

## 1.4 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

### 1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

### 1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For installer and installation supervisor.
- C. Maintenance Data: For splices and connectors to include in maintenance manuals.

### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- C. 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.
- D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- E. Grounding: Comply with ANSI-J-STD-607-A.

### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.

### 1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

### 1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

## PART 2 - PRODUCTS

## 2.1 UTP CABLE

- 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. Belden CDT Inc.; Electronics Division.
  2. CommScope, Inc.
  3. Genesis Cable Products; Honeywell International, Inc.
  4. SYSTIMAX Solutions; a CommScope Inc. brand.
- B. Description: 100-ohm, 50-pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
  2. Comply with TIA/EIA-568-B.1 for performance specifications.
  3. Comply with TIA/EIA-568-B.2, Category 5e.
  4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Communications, General Purpose: Type CM or CMG; or MPP, CMP, MPR, CMR, MP, or MPG.

## 2.2 UTP CABLE HARDWARE

- 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. CommScope, Inc.
  2. Hubbell Premise Wiring.
  3. Leviton Voice & Data Division.
  4. Panduit Corp.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: **[One]** <Insert number> for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
1. Number of Jacks per Field: One for each four-pair **[UTP cable indicated] [conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria]**.

- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- G. Patch Cords: Factory-made, 4-pair cables in [**36-inch**] [**48-inch**] <Insert length>lengths; terminated with 8-position modular plug at each end.
  - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
  - 2. Patch cords shall have color-coded boots for circuit identification.

### 2.3 OPTICAL FIBER CABLE

- 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. CommScope, Inc.
  - 2. Corning Cable Systems.
  - 3. SYSTIMAX Solutions; a CommScope Inc. brand.
- B. Description: Multimode, [**50/125**] [**62.5/125**]-micrometer, [**24**] <Insert number>-fiber, [**nonconductive**, ]tight buffer, optical fiber cable.
  - 1. Comply with ICEA S-83-596 for mechanical properties.
  - 2. Comply with TIA/EIA-568-B.3 for performance specifications.
  - 3. Comply with [**TIA/EIA-492AAAA-B**] [**TIA/EIA-492AAAA-A**] for detailed specifications.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    - a. General Purpose, Nonconductive: Type OFN or OFNG[, **or OFNR, OFNP**].
    - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    - c. Riser Rated, Nonconductive: Type OFNR[ **or OFNP**], complying with UL 1666.
    - d. General Purpose, Conductive: Type OFC or OFCG[; **or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP**].
    - e. Plenum Rated, Conductive: Type OFCP[ **or OFNP**], complying with NFPA 262.
    - f. Riser Rated, Conductive: Type OFCR[; **or OFNR, OFCP, or OFNP**], complying with UL 1666.
  - 5. Conductive cable shall be [**steel**] [**aluminum**] armored type.
  - 6. Maximum Attenuation: [**3.50**] <Insert number> dB/km at 850 nm; [**1.5**] <Insert number> dB/km at 1300 nm.
  - 7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- C. Jacket:
  - 1. Jacket Color: [**Aqua for 50/125-micrometer cable**][**Orange for 62.5/125-micrometer cable**].
  - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
  - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

### 2.4 OPTICAL FIBER CABLE HARDWARE

- 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. Corning Cable Systems.
2. Hubbell Premise Wiring.
3. Siemon Co. (The).
4. <Insert manufacturer's name>.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: [One] <Insert number> for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.

D. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
2. Quick-connect, simplex and duplex, [Type SC] [Type ST] [Type LC] [Type MT-RJ] connectors. Insertion loss not more than 0.75 dB.
3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

## 2.5 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

## 2.6 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

## 2.7 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Cable will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 ENTRANCE FACILITIES



- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

### 3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters[ **and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used**]. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
  - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 10. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
  - 11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
  - 1. Comply with TIA/EIA-568-B.2.
  - 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than [60 inches] <Insert dimension> apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable [6 feet] <Insert size> long not less than [12 inches] <Insert size> in diameter below each feed point.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

### 3.4 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."

- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
  - 1. Administration Class: [1] [2] [3] [4].
  - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for [Class 2] [Class 3] [Class 4] level of administration[ **including optional identification requirements of this standard**].
- D. Comply with requirements in Division 27 Section "Communications Horizontal Cabling" for cable and asset management software.
- E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, [**backbone pathways and cables,**] [**entrance pathways and cables,**] terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- G. Cable and Wire Identification:
  - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.

4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
  - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
  - b. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

### 3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
  - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical Fiber Cable Tests:

- a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- b. Link End-to-End Attenuation Tests:
  - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
  - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 271300

## SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

## 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. UTP cabling.
2. Coaxial cable.
3. Cable connecting hardware, patch panels, and cross-connects.
4. Telecommunications outlet/connectors.
5. Cabling system identification products.

## B. Related Sections:

1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

## 1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- G. RCDD: Registered Communications Distribution Designer.
- H. UTP: Unshielded twisted pair.

## 1.4 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
  - 1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
  - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
  - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

#### 1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For Installer and installation supervisor.
- C. Maintenance Data: For splices and connectors to include in maintenance manuals.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- C. 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.
- D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- E. Grounding: Comply with ANSI-J-STD-607-A.

#### 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## 1.9 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

## PART 2 - PRODUCTS

### 2.1 UTP CABLE

- A. Description: 100-ohm, 4-pair UTP, binder groups covered with a blue thermoplastic jacket.
  - 1. Comply with ICEA S-90-661 for mechanical properties.
  - 2. Comply with TIA/EIA-568-B.1 for performance specifications.
  - 3. Comply with TIA/EIA-568-B.2, Category 6.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Communications, General Purpose: Type CM or CMG; or MPP, CMP, MPR, CMR, MP, or MPG.

### 2.2 UTP CABLE HARDWARE

- A. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- B. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- C. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
  - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
  - 1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit 25 percent expansion criteria.
- E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.



- F. Patch Cords: Factory-made, four-pair cables in 48-inch lengths; terminated with eight-position modular plug at each end.
  - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

### 2.3 COAXIAL CABLE

- A. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- B. RG-11/U: NFPA 70, Type CATV.
  - 1. No. 14 AWG, solid, copper-covered steel conductor.
  - 2. Gas-injected, foam-PE insulation.
  - 3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
  - 4. Jacketed with sunlight-resistant, black PVC or PE.
  - 5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.
- C. RG-6/U: NFPA 70, Type CATV.
  - 1. No. 18 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
  - 2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.
  - 3. PVC jacket.
- D. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
  - 1. CATV Cable: Type CATV, or CATVP or CATVR.

### 2.4 COAXIAL CABLE HARDWARE

- A. Coaxial-Cable Connectors: Type F, 75 ohms.

### 2.5 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: Two-port-connector assemblies mounted in single gang faceplate.
  - 1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."
  - 2. For use with snap-in jacks accommodating any combination of UTP and coaxial work area cords.
    - a. Flush mounting jacks.
  - 3. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

## 2.6 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

## 2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

## 2.8 SOURCE QUALITY CONTROL

- A. Factory test UTP cables according to TIA/EIA-568-B.2.
- B. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- C. Cable will be considered defective if it does not pass tests and inspections.

## PART 3 - EXECUTION

### 3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
  - 1. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
  - 2. Comply with requirements for cable trays specified in Division 26 Section "Cable Trays for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.2 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with requirements for cable trays specified in Division 26 Section "Cable Trays for Electrical Systems."
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings."

- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits 3 inches above finished floor.
  - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

### 3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
  - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 9. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
  - 10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
  - 1. Comply with TIA/EIA-568-B.2.
  - 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Open-Cable Installation:
  - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

### 3.4 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

- B. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- C. Cable and Wire Identification:
1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  3. Exposed Cables and Cables in Cable Trays: Label each cable at intervals not exceeding 15 feet.
  4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.
  5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- D. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
1. Cables use flexible vinyl or polyester that flex as cables are bent.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
1. Visually inspect UTP cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
  2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
  3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  5. UTP Performance Tests:

- a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
  - 1) Wire map.
  - 2) Length (physical vs. electrical, and length requirements).
  - 3) Insertion loss.
  - 4) Near-end crosstalk (NEXT) loss.
  - 5) Power sum near-end crosstalk (PSNEXT) loss.
  - 6) Equal-level far-end crosstalk (ELFEXT).
  - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
  - 8) Return loss.
  - 9) Propagation delay.
  - 10) Delay skew.
6. Coaxial Cable Tests: Conduct tests according to Division 27 Section "Educational Media Management, Retrieval and Control System."
7. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
  - a. Voice-over-IP and Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

### 3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 271500

## SECTION 275116.50 – GYM / CAFE SOUND SYSTEM

## 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. Power amplifier.
2. Microphones.
3. Digital audio processor.
4. Volume/program selection control panel.
5. Equipment cabinet.
6. Loudspeakers.
7. Microphone outlets.
8. Conductors and cables.
9. Raceways.

- B. The Gym / Café sound system shall be (2) discreet and independent systems. All requirements set forth in this document shall apply to both systems, unless specifically noted otherwise (i.e. if a quantity is given for a specific type of equipment, it shall mean that that quantity shall be provided for each system).

## 1.3 DEFINITIONS

- A. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.
- B. Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For equipment cabinets and components. Include plans, elevations, sections, details, and attachments to other work.
  1. Wiring Diagrams: For power, signal, and control wiring.
    - a. Identify terminals to facilitate installation, operation, and maintenance.
    - b. Single-line diagram showing interconnection of components.
    - c. Cabling diagram showing cable routing.

- C. Operation and Maintenance Data: For gym / cafe sound system to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain gym / cafe sound systems from single source.
- C. 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.
- D. Comply with NFPA 70.

#### 1.6 COORDINATION

- A. Coordinate layout and installation of system components and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

#### 1.7 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. Desk Stand: One.
  - 2. Floor Stand: Two; equal to Atlas MS-12C.
  - 3. Microphone cords: Two, each 25 feet long, with XLR connections.
  - 4. XLR to mini-jack interface for MP3 players, laptops, CD, etc.: One.

### 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. ATM Fly-Ware; a subsidiary of Adaptive Technologies Group. (ATM)
  - 2. Astatic. (Astatic)
  - 3. Atlas Sound. (Atlas)
  - 4. Biamp Systems. (Biamp)
  - 5. Electro-Voice; a subsidiary of Bosch Communications Systems. (Electro-Voice)
  - 6. Lowell Manufacturing. (Lowell)
  - 7. Middle Atlantic Products. (Middle Atlantic)
  - 8. QSC Audio Products, LLC. (QSC)
  - 9. Shure Incorporated. (Shure)
  - 10. West Penn Wire. (West Penn)
  - 11. Whirlwind Music Distributors, Inc. (Whirlwind)



## 2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

### A. System Functions:

1. Selectively connect any zone to any available signal channel.
2. Selectively control sound from microphone outlets and other inputs.
3. Reproduce high-quality sound that is free of noise and distortion at all loudspeakers at all times during equipment operation including standby mode with inputs off; output free of nonuniform coverage of amplified sound.

## 2.3 GENERAL EQUIPMENT AND MATERIAL REQUIREMENTS

- A. Compatibility of Components: Coordinate component features to form an integrated system. Match components and interconnections for optimum performance of specified functions.
- B. Equipment: Comply with UL 813. Equipment shall be modular, using solid-state components, and fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.
- C. Equipment Mounting: Where cabinet mounting is indicated, equipment shall be designed to mount in a 19-inch housing complying with TIA/EIA-310-D.

## 2.4 POWER AMPLIFIER

- A. QSC RMX Series dual-channel amplifier, or equivalent.
- B. Mounting: Rack.
- C. Output Power: Selectable at 4 and 8 ohm (low impedance) in 2-channel pairs.
1. Model RMX2450, 500 Watts per channel.
- D. Total Harmonic Distortion: Less than 0.02 percent at full rated power output at 1 kHz.
- E. Frequency Response: +0 to -1 dB at 1 Watt from 20 Hz to 20 kHz; -3 dB at full power from 5 Hz to 50 kHz.
- F. Controls: On-off, and input levels.
- G. Input Sensitivity: 1.23 V (+4.0 dBu).

## 2.5 MICROPHONES

### A. Hand-held Microphone:

1. Astatic CTM 77 or Shure SM-58.
2. Type: Electret condenser, with cardioid polar characteristic.
3. Frequency Response: Uniform, 50 to 18,000 Hz.
4. Output Level: Minus 55 dB.
5. Finish: Black.
6. Mounting: Desk- or floor-stand with lockable, press-to-talk switch.
7. Quantity: 2.

## 2.6 DIGITAL AUDIO PROCESSOR

- A. Biamp Nexia™ CS digital signal processor, or equivalent.
- B. Performance Requirements:
  - 1. Frequency Response: 20 to 20,000 Hz at +4 dBu: +0/-0.4 dB.
  - 2. Total Harmonic Distortion (+N): 20 to 20,000 Hz at +4 dBu, +0/-0.4 dB;
    - a. Line level: Less than 0.006%.
    - b. Mic level: Less than 0.05%.
  - 3. Equivalent Input Noise: 20 to 20,000 Hz, 66 dB gain, 150 ohm: -125 dBu.
  - 4. Dynamic Range: 20 to 20,000 Hz, 0dB: At least 105 dB.
  - 5. Maximum Gain: Mic input to line output: 66 dB.
  - 6. Crosstalk (channel-to-channel @ 1 kHz):
    - a. Line level input: Less than -80 dB.
    - b. Mic level input: Less than -75 dB.
  - 7. Input impedance (mic/line balanced): 8k Ohms.
  - 8. Maximum Input (mic/line balanced): +24 dBu.
  - 9. Input Gain Range (variable): 0 dB to +66 dB.
  - 10. Output Impedance (balanced): 200 Ohms.
  - 11. Maximum Output (balanced): +24 dBu.
  - 12. Sampling Rate: 48 kHz.
  - 13. A/D and D/A Converters: 24-bit.
  - 14. Phantom Power: +48 VDC (7mA/input).
  - 15. Inputs: 10 balanced mic/line inputs on plug-in barrier strip.
  - 16. Outputs: Six balanced outputs on plug-in barrier strip.
  - 17. Ethernet port for software configuration/control.
  - 18. Serial port for third-part RS-232 remote control.
  - 19. Rack mounting.

## 2.7 VOLUME / PROGRAM SELECTION CONTROL PANEL

- A. Biamp Volume/Select 8 Control Panel, or equivalent.
  - 1. The control panel shall provide two push-button rotary encoders and LED indicators, mounted on a two-gang electrical plate, which shall fit in a standard double-gang back-box. The control panel shall provide programmable remote control of both volume and selection functions.
- B. Minimum Performance Requirements:
  - 1. Adjustment of eight selectable system volumes.
    - a. Volumes are any individual or grouped system levels.
    - b. Volumes include inputs, outputs, matrix cross-points, etc.
  - 2. Initiation of eight selectable system programs.
    - a. Programs are any individual or grouped system operation.
    - b. Programs include presets, mutes, ducking, combining, etc.

3. Control functions can be made to change along with presets.

2.8 EQUIPMENT CABINET (Gym only):

- A. Lowell L253-12 cabinet, or equivalent, with perforated steel door.
- B. Comply with TIA/EIA-310-D.
- C. House amplifier, digital signal processor and auxiliary equipment.
- D. Cabinet Housing:
  1. Constructed of 16-gauge steel, minimum, with front- and rear-locking doors and standard TIA/EIA-310-D-compliant, 19-inch racks.
  2. Arranged for wall mounting as indicated.

2.9 EQUIPMENT CABINET (Cafe only):

- A. Middle Atlantic SRS-2-12 rotating slide-out equipment rack, or equivalent.
- B. House amplifier, digital signal processor and auxiliary equipment.
- C. Cabinet Housing:
  1. Rough-in pan shall be constructed of 14-gauge steel. Trim/locking panel shall lock rack in closed position and be 11-gauge aluminum with a black brushed and anodized finish.
  2. Rackrail shall be 11-gauge steel with tapped 10-32 holes in universal EIA spacing, finished in black e-coat with marked rackspaces.
  3. Rack shall pull out on integrated ball bearing slides and rotate 90 degrees for equipment servicing.
  4. Arranged for shelf-mounting as indicated.

2.10 LOUDSPEAKERS

- A. Loudspeakers (Gym only):
  1. Electro-Voice QRx-115/75, or equivalent.
  2. Type: Two-way, full-range loudspeaker with 15-inch transducer with a cast aluminum basket as the LF component and one 3-inch diameter voice coil/diaphragm compression driver as the HF component. Driver shall be mounted on an asymmetrical 75-degree x 50-degree fully rotatable constant-directivity horn.
  3. Frequency Response: Minus 3 dB from 60 to 15,000 Hz; minus 10 dB from 45 Hz to 16,000 Hz.
  4. Axial Sensitivity:
    - a. SPL, 1 Watt @ 1 meter, passive: 98 dB.
    - b. SPL, 1 Watt @ 1 meter, biamp (LF/HF): 98/110 dB.
  5. Impedance: Passive: 8 Ohms; Biamp (LF/HF): 8/8 Ohms.
  6. Finish: White.
  7. Mounting: Each speaker shall be mounted via an ATM "One-Way-Array" rigging and aiming system.
- B. Loudspeakers (Café and Platform only):

1. Electro-Voice ZX1i-90, or equivalent.
2. Frequency Response: Minus 3 dB from 60 Hz to 20,000 Hz.
3. Axial Sensitivity: 1 Watt @ 1 meter: 94 dB.
4. Impedance: 8 Ohms.
5. Mounting: Integral surface mounting bracket.
6. Finish: White.

## 2.11 OUTLETS

- A. Microphone Outlet: Whirlwind, or equivalent. Two, three-pole, polarized, locking-type, microphone receptacles in single-gang boxes. Equip outlets with brushed aluminum device plates.

## 2.12 CONDUCTORS AND CABLES

### A. Speaker Cables:

1. Stranded bare copper, unshielded and unjacketed.
2. Insulation: PVC/Nylon. 0.015-inch PVC, 0.005-inch Nylon nominal thickness.

### B. Microphone Cables:

1. Paired, stranded tinned copper, shielded with an overall jacket.
2. Insulation: Polypropylene, 0.008-inch nominal thickness.
3. Shield: 100% Aluminum polyester foil.
4. Drain: Stranded tinned copper.
5. Jacket: PVC, 0.02-inch nominal thickness.

## 2.13 RACEWAYS

- A. Conduit and Boxes: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

1. Outlet boxes shall be not less than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

## PART 3 - EXECUTION

### 3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

- B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.2 INSTALLATION OF RACEWAYS

- A. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

### 3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Cable Installation Requirements:
  - 1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
  - 2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
  - 3. Secure and support cables not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
  - 5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
- C. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

### 3.4 INSTALLATION

- A. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- B. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.
- C. Equipment Cabinets:
  - 1. Arrange all inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.
  - 2. Blank Panels: Cover empty space in equipment racks so entire front of rack is occupied by panels.
- D. Volume/Program Selection Control Panel: Connect each zone to the control panel. Install in gymnasium where noted. Provide wire guard similar to fire alarm pull station for protection.
- E. Wall-Mounted Outlets: Flush mounted.

- F. Conductor Sizing: Unless otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.
- G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.5 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. Schedule tests with at least seven days' advance notice of test performance.
  2. After installing gym / cafe sound system and after electrical circuitry has been energized, test for compliance with requirements.
  3. Operational Test: Perform tests that include originating program and page messages at microphone outlets, and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.
  4. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
    - a. Disconnect microphone at connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure signal-to-noise ratio.
    - b. Repeat test for each separately controlled zone of loudspeakers.
    - c. Minimum acceptance ratio is 50 dB.
  5. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.
  6. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.
  7. Power Output Test: Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.

8. Signal Ground Test: Measure and report ground resistance at public address equipment signal ground. Comply with testing requirements specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

D. Gym / cafe sound system will be considered defective if it does not pass tests and inspections.

### 3.7 STARTUP SERVICE

A. Perform startup service.

1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.

2. Complete installation and startup checks according to manufacturer's written instructions.

### 3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain the gym / cafe sound system and equipment.

END OF SECTION 275116

## SECTION 275123- PHONE SYSTEM

## 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: IP Business Phone with the following components:

1. IP Based Enterprise Communications System
2. VoIP IP Endpoints Including:
  - a. Single Line IP Phones
  - b. Multi Line IP Phones
3. Integrated Service Routers

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For phone system. Include plans, elevations, sections, details, and attachments to other work.
  1. Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
  2. Include scaled drawings for station arrangement of built-in equipment.
  3. Wiring Diagrams: For power, signal, and control wiring.
    - a. Identify terminals to facilitate installation, operation, and maintenance.
    - b. Single-line diagram showing interconnection of components.
    - c. Cabling diagram showing cable routing.
- C. Operation and Maintenance Data: For phone system to include in operation and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  1. A record of Owner's equipment-programming option decisions.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

## PART 2 - PRODUCTS



## 2.1 MANUFACTURERS

- A. Manufacturer: Cisco Systems, Inc.
  - 1. 2800 Series, to match phone system utilized by Portland Public School District.

## 2.2 FUNCTIONAL DESCRIPTION OF TELEPHONE SYSTEMS

- A. Cisco 2811 Integrated Service Router for communication with Central system located at PATHS via the existing INET fiber line.
- B. Integrated central system with the following:
  - 1. Direct-dial, full duplex private telephone communications between all locations equipped with telephones.
  - 2. Initial system operation with:
    - a. 100 VOIP User Licenses with support up to 500 Users
    - b. 8 – G7.11 IP Gateway Ports
    - c. 4 – FXO Loop Start or Ground Start Trunk Ports with support up to 36
    - d. 4 – Analog FSX Station ports with support up to 52
  - 3. System must be capable of being expanded to utilize:
    - a. 8 – DID trunk ports
    - b. Support up to 12-T1/PRI or 72 SIP Trunks
  - 4. System must include two redundant hard drives, configured as RAID1. Hard drives to provide a minimum of 64 gigabytes of storage capacity for applications such as voicemail, call recording and backup.
  - 5. System must be completely configurable from a central application. System features to be administered by this central interface include but are not limited to:
    - a. Desktop Call Management
    - b. Call Recording
    - c. Reporting
    - d. Unified Communications
    - e. Voicemail
    - f. Auto Attendant
    - g. Contact Center
    - h. Conference Manager
    - i. Fax Manager
  - 6. System must be rack mountable in a standard 19” rack
  - 7. System must be capable of self system monitoring that diagnoses critical hardware and system services. In the event that there is a hardware failure or software error, the fault management module automatically takes corrective action. If the problem continues, the fault monitoring system can notify an administrator. In addition fault management module also provides a dedicated dial-in modem facility, which is independent of the primary operating system, to facilitate remote diagnostics even under catastrophic failure conditions.
  - 8. Complete system management must be available from any remote PC using Internet Explorer Web Browser. Client applications and terminal based programming are not acceptable. The web based programming interface shall be capable of the following:

- a. Web based administration over IP (LAN or WAN) or dial up connection to an integrated modem.
  - b. Customizable authentication schemes and access permissions
    - 1) Support local user accounts or Windows Domain Authentication
    - 2) Support access control list at a task level to provide different levels of access to administrative users.
  - c. PBX Administration – Integrated tools for:
    - 1) Voicemail and auto attendant administration
    - 2) Trunk configuration and routing for analog, digital and SIP trunks
    - 3) Dial plan management
    - 4) SNMP alarms and settings
    - 5) DSP resource management
    - 6) Software updates
    - 7) System backup and restore
    - 8) Management of Music on Hold channels
    - 9) License Management
  - d. Diagnostics
    - 1) Real time view, providing hardware and card details
    - 2) Trunk monitoring tools for verification of digital and analog trunk wiring and configuration
    - 3) Real time traces for call progress, voicemail activity and WAN protocol traces for IP, Frame Relay, HDLC, Ethernet and others.
    - 4) Monitoring of station status such as on hook, off hook, forward, DND and others for digital stations.
    - 5) Integrated on box call detail reports
    - 6) Extensive system logs for diagnostics and auditing.
9. System Call Control shall be available from any computer on the network to graphically control the system calls and their personal extension features. The system call control shall be capable of the following:
- a. Originate calls: Use telephone numbers or extensions, directory entries, call logs, contact information from other applications, desktop shortcuts or voice mail information to originate a call.
  - b. Call management: provides a host of graphical usability tools such as:
    - 1) Visual incoming caller identification with pop-up notification and call controls
    - 2) Standard call control buttons including conference, transfer, hold, park, retrieve, mute
    - 3) Visually add and drop parties from a conference call
    - 4) Call screening and optionally send calls to voicemail
    - 5) Do not disturb: immediately transfer all calls to voicemail
    - 6) Call recording, either an entire call or segments
    - 7) Caller announce: have the incoming caller name audibly announced
  - c. Call Monitor: provides real-time visual display of incoming, outgoing and in-progress call information including: Call owner, start time, duration, status, group, DID, name, target station, trunk number, user, notes, priority, account code, and parked calls.
  - d. Extension View: A pane for viewing the status of various users lines on the system including phone status, line number, name, title, forwarding status, DID, workgroup, etc.

- e. Voice Messages: A pane for viewing and manipulating voice messages including the ability to play messages, view name/number of the sender, view date/time/length of messages, reply to messages via a return message or phone call, mark messages as read/unread/private, and send a voicemail as an audio attachment to an e-mail.
- f. Advanced Call Management: Configure, forwarding and Do Not Disturb.
- g. Supervise Calls In Progress: Provides the ability for users with the appropriate privileges to listen to an active call or join an active call in progress.

#### C. Integrated System Voicemail

##### 1. Features

- a. Play Message
- b. Forward Message
- c. Forward Messages with Comments
- d. Record & Send Messages
- e. Remote Access to Voicemail
- f. Call out from Voicemail
- g. Bookmark Voicemails
- h. Reply with message
- i. Return to Voicemail
- j. Private Messaging
- k. User-to-user messages
- l. Priority Delivery
- m. Message review controls: Rewind, Fast Forward, Pause

#### D. Automated Attendant Key Features

- 1. Ability to choose whether a live receptionist or auto attendant answers and to switch between them at any time.
- 2. Auto attendants are transparent to direct-dial (DID), so the same trunk can be used for direct calls to a private number and callers who will dial an extension.
- 3. Place different auto attendants on different trunks to offer different customer services for different incoming phone numbers.
- 4. Auto attendants are schedulable and can be configured to automatically change greetings and call routing based on time of day or specific dates such as holidays.
- 5. Built-in dial-by-name directory lets callers look up users by entering their name using their telephone keys. The dial-by-name directory can be based on first name, last name, or both.
- 6. Any user can choose to be exempted from the dial-by-name directory, so callers cannot dial them by name.
- 7. Clickable audio controls to record greetings, messages, and menu prompts.
- 8. Ability to record auto attendant messages off-site or professionally and easily import them into the auto attendant.
- 9. Customizable options for when callers make no selection, such as repeating the menu, transferring to an Operator or to voicemail.
- 10. Fax tone detection that automatically routes incoming faxes to a fax station.

#### E. Remote Stations:

##### 1. IP Phones – Cisco 7911G:

- a. Lighted Hold and Menu keys
- b. Lighted Message Waiting indicator.
- c. Graphical display: Monochrome with 192 x 64 pixel resolution and scrollable 3-line access to calling features.
- d. Four soft-key buttons and scroll toggle bar.

- e. Network features: Cisco Discovery Protocol; IEEE 802.1 p/q tagging and switching
- f. Ethernet switch: 10/100BASE-T connection through two RJ-45 ports.
- g. Volume control.
- h. Multiple ring tones: Minimum of 24 user-adjustable tones.
- i. Voice Quality: Comfort-noise generation and voice-activity-detection (VAD) programming on a system basis.
- j. Power Options: Cisco PoE or IEEE 802.3af PoE.
- k. Quantity: 75 to be installed at each wall station shown, with the remainder located as directed by Owner.

2. Multi-Line IP Phones – Cisco 7941G:

- a. Messages: Direct access to voicemail.
- b. Directories: Identifies incoming messages and categorizes them on the screen.
- c. Settings: Allows adjustment of contrast and selection of ringer sounds.
- d. Help: Online help with information about phone keys, buttons, and features.
- e. Graphical Display: 4-bit grayscale display with 320 x 222 resolution.
- f. Speakerphone, Mute and Handset buttons.
- g. Ethernet switch: Internal 2-port for direct connection to 10/100BASE-T connection.
- h. Headset port.
- i. Volume control.
- j. Voice Quality: Comfort-noise generation and voice-activity-detection (VAD) programming on a system basis.
- k. Power Options: Cisco PoE or IEEE 802.3af PoE, plus 48 VDC power supply.
- l. Quantity: 7 to be located as directed by Owner.

2.3 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

- A. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.
- B. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.
- C. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz. Comply with UL 813.

2.4 CONDUCTORS AND CABLES

- A. All System Wiring shall be on Category 6 Cable.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.2 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements:
  - 1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
  - 2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
  - 3. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
  - 5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
- C. Open-Cable Installation:
  - 1. Install cabling with horizontal and vertical cable guides in telecommunication spaces with terminating hardware and interconnection equipment.
  - 2. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.

### 3.3 INSTALLATION

- A. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

### 3.5 SYSTEM PROGRAMMING

- A. Programming: Fully brief Owner on available programming options. Record Owner's decisions and set up initial system program. Prepare a written record of decisions, implementation methodology, and final results.

## 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
- C. Phone system will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

## 3.7 DEMONSTRATION

- 1. Train Owner's maintenance personnel on programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining the system and equipment. A minimum of 4 hours of training shall be provided.

END OF SECTION 275123

## SECTION 275123.50 - EDUCATIONAL INTERCOMMUNICATIONS AND PROGRAM 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: Microprocessor-switched intercommunications and program systems with the following components:
  - 1. All-call amplifier.
  - 2. Intercommunication amplifier.
  - 3. Paging amplifier.
  - 4. Loudspeakers/speaker microphones.
  - 5. Conductors and cables.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For educational intercommunications and program systems. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
    - a. Identify terminals to facilitate installation, operation, and maintenance.
    - b. Single-line diagram showing interconnection of components.
    - c. Cabling diagram showing cable routing.
- C. Qualification Data: For qualified installer.
- D. Operation and Maintenance Data: For educational intercommunications and program systems to include in operation and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. A record of final matching transformer-tap settings and signal ground-resistance measurement certified by Installer.
  - 2. A record of Owner's equipment-programming option decisions.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: The Contractor shall be from an established and local company providing solutions to the school market for a minimum of three years with Telecom/Data/Sound Experience.

- B. Source Limitations: Obtain educational intercommunications and program systems from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for location and application.
- D. Comply with NFPA 70.

## 1.5 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted speaker microphones and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Valcom Inc., Class Connection™ ES, or comparable products by one of the following:
  1. Bogen Communications, Inc.
  2. Dukane Communication Systems; part of GE Infrastructure, Security.
  3. Rauland-Borg Corporation.

### 2.2 FUNCTIONAL DESCRIPTION OF MICROPROCESSOR-SWITCHED SYSTEMS

- A. Intercom Control Unit:
  1. Shall be capable of expanding to 720 (seven hundred twenty) points. A point is defined as a call-in switch or speaker output.
  2. Provide pre-alert tone to classroom for intercom calls and general announcements.
  3. Ability to program and control the built-in master clock with unlimited events and unlimited time schedules with multiple audio groups.
  4. Ability to control wireless or wired clocks (various correction methods).
  5. Ability to produce user defined tone signals for time tones or emergency tones.
  6. Ability to select the tone on an all-call basis from any, or selected, administrative telephones.
  7. Provide an RS-232 and Ethernet port, which will give ability to monitor operations and functions of the systems.
  8. Provide off-site programming and diagnostics of the system. It shall also be capable of determining basic circuit faults.
  9. The system shall be capable of simultaneous conversations between administrative ports.
  10. The system shall have a Windows® based PC administration programming tool which allows the administrative personnel to easily manage Audio Sources, Class Change schedules, paging groups, time updates, holiday schedules and day/night mode operation from their desktop PC. It shall also have the ability to activate on board WAV files on a schedule and/or immediately in the event of an emergency at the highest priority override level.
  11. System shall provide calendar based scheduling up to one year in advance.
  12. The system shall be programmable via Ethernet or direct COM port cable connection.
  13. System shall be capable of utilizing 45-ohm or 25-volt speakers for classroom type speakers.
  14. System speakers shall be capable of utilizing standard CAT 6 telephone/data wiring for installation, thus allowing for only one type of wiring infrastructure within the school. The



speakers shall be capable of utilizing spare pairs in the telephone wire connected to the classroom, allowing for lower installation cost.

15. Provide eight unrestricted audio paths for communication between administrative phones, program material, time tone distribution, and paging.
16. Provide six software programmable pushbutton inputs that can be used to activate tones, emergency tones, time tones, schedules, set system time, force a holiday schedule, door entry, etc.
17. Provide eight software programmable output contact closures which can be activated manually to turn on cameras, unlock doors, emergency lockdown, etc., or automatically via Master Time Control Center.
18. Provide voice-synthesized call-in, which allows the administrative telephones to hear the incoming intercom call's room number over the handset.
19. Provide call confirmation tone at speaker when an intercom call is placed. This verifies that the call has been placed in queue. If the call is upgraded to an emergency, a second confirmation tone shall be activated.
20. Automatically announce the architectural room number over any one, group, or all speakers if an emergency call-in goes unanswered.
21. Provide Emergency Override On Board Voice Messaging via the following methods:
  - a. Any authorized PC on the schools LAN/WAN
  - b. Any authorized telephone

B. Speaker-Microphone Station:

1. Having privacy from remote monitoring without a warning tone signal at monitored station.
2. Communicating hands free.
3. Calling master station by actuating call switch.
4. Returning a busy signal to indicate that station is already in use.

C. Speakers: Free of noise and distortion during operation and when in standby mode.

2.3 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

- A. Direct dialed, hands-free, two-way communication from all administrative telephones to any location equipped with a talkback speaker.
- B. Automatic gain control on intercom speech to assure constant talkback speech level.
- C. Microprocessor based system capable of handling up to 720 points. A point is defined as a call-in switch or a speaker output.
- D. System shall be modular in design and capable of expanding in increments of 48 points allowing for budget flexibility and expandability.
- E. System shall interface with any telephone system, thus allowing the school(s) to upgrade or replace their telephone system without suffering a requirement to replace, or lose any feature of, their internal communications (intercom) system. Any system that limits system features based upon any selected telephone system, and/or is proprietary to one or only a few telephone systems shall not be acceptable.
- F. Automatically sound a tone or play a pre-page WAV file over any loudspeaker connected for two-way communication to alert the classroom teacher that this two-way call has been established. This is intended to prevent unauthorized monitoring. The privacy tone must repeat every 15 seconds.
- G. Distribution of emergency announcement(s) from any authorized telephone to all areas furnished with a loudspeaker. Emergency announcements shall have the highest system priority.
- H. Distribution of general announcements from any administrative telephone, staff telephone, or classroom telephone. The system shall be capable of providing all-call, group call, multiple group call, or dial-on-the-fly page groups.

- I. Classroom speakers shall be software assignable to any or all of 72 audio groups.
- J. Provide the ability to define and archive unlimited time tone schedules with up to 255 events per schedule. Each scheduled event shall be capable of controlling any one of 6 internal tones; user selected custom audio/voice phrases, audio from any of 3 auxiliary sources or up to 40 relays for building control. Each scheduled audio event shall be distributable to up to 72 audio groups. The system shall feature the ability to automatically initiate up to 8 schedules per day, based upon the day of the week or calendar dates up to one year in advance. Up to 8 daily schedules shall operate simultaneously. Schedule administration, modification and creation functions must be available through administration PC software.
- K. Provide 3- or 4-digit numbering plan, thus allowing the classroom speaker and the classroom telephone to be the same architectural number.
- L. Provide facilities for up to seven call-in priority levels. The priority levels shall be as follows:
  - 1. Normal
  - 2. Security
  - 3. Normal/Emergency
  - 4. Urgent/Emergency
  - 5. Overhead Ring
  - 6. Emergency Only
  - 7. Ignore
- M. Priority levels shall determine call queue placement. Emergency calls will be answered first; urgent calls second and normal calls last.
- N. System shall be capable of placing intercoms call on hold in order to perform other administrative functions.
- O. Any classroom/area loudspeaker must have the flexibility to be programmed as a testing room. A testing room shall be excluded from receiving general announcements, class change tones, group announcements and program material. The testing room must receive emergency tones and announcements. A dial code must be provided that will access these testing rooms at the same time, allowing for an announcement to the testing rooms for applications such as standardized testing. The testing rooms may be reactivated to normal operation at any time by the administration staff as needed. Testing rooms shall automatically be reset to normal operation before start of class the next day.
- P. Programmable features shall be stored in non-volatile memory and shall not be lost due to power failures.
- Q. Classroom initiated intercom calls must be able to be assigned to ring at specific administrative ports. These administrative ports shall have the flexibility to be forwarded to other administrative ports should a call go unanswered or should the assigned administrative port be busy.
- R. Facilities to annunciate incoming intercom calls at multiple administrative phones simultaneously. Calls may be answered from any of the administrative telephones by simply lifting handset, dialing the room number or pressing a button on telephone. Once answered, the call will automatically be cancelled for other administrative phones.
- S. System functionality must include the capability to manually distribute up to 5 (five) alert emergency tones via pushbuttons, contact closure, or dial up tones from any administrative telephone. These tones shall be customizable with respect to cadence, type and duration. Dial up tones must only be accessible by authorized users.
- T. The system must provide a minimum of 4 (four) ports to be connected to the telephone system from the intercom system. These 4 (four) intercom lines shall provide built-in Enhanced Caller Line Identification which will visually announce the name of the teacher or location, the architectural classroom number, and the status of the call-in level; thus allowing interfacing to any telephone system.

- U. The system shall have the ability to control all system relays. Relays shall be controlled through the administrative software, DTMF controlled, automatically cycle at a programmed time of day, follow time schedule events, follow audio group events, follow security calls, and follow emergency and ADA calls. All relays must be software programmable with the flexibility to change as required.
- V. The system shall provide at least three simultaneously operating, non-restrictive program distribution channels. The audio program material shall be controlled and distributed with administration PC software allowing simple and easy changes.
- W. The Communication System shall feature voice call progress. When 2 or more system users attempt to announce into the same area, the unsuccessful user shall be notified via a voice message. When a user's announcement attempt is overridden by a higher priority announcement, the overridden user shall be notified via a voice message.
- X. The system shall have the ability to store WAV files directly onto the CPU and shall not be lost due to power outage.
- Y. The WAV files shall be activated via the Administration Software, Telephone and/or Telephone system, and/or pushbuttons.
- Z. The WAV files shall be programmable as to what level of priority they can be broadcast. They shall be programmable as to override any class change tones, normal all call, music, and intercom in the event of an emergency.
- AA. The WAV files shall also have the ability to be broadcast into any one or all of the 72 audio groups as well to any zone within the system.
- BB. The WAV files shall be have the ability to be broadcast via a schedule for any day of the week or time of the day. They shall also have the ability to be broadcast for any duration of time and repeat number of plays with the ability to select how long the duration is between each repeated broadcast.
- CC. The WAV files shall be able to be broadcast via a pushbutton. When this pushbutton is activated it shall be programmable to select which WAV file is broadcast, the priority level, where it is broadcast, and how many times it shall play.
- DD. The WAV files shall also have the ability to be a part of the class change tones within the system. These files shall be able to replace any tone within the class change schedules as to offer the flexibility of customizable tones and or phrases in this class change mode.
- EE. The WAV files shall be programmable as to replace the hands-free alert tone, repeated alert tone, or the all call alert tones.

#### 2.4 ALL-CALL AMPLIFIER

- A. Output Power: 70-V balanced line. 80 percent of the sum of wattage settings of connected for each station and speaker connected in all-call mode of operation, plus a 10-percent allowance for future stations.
- B. Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to quantity of stations connected in all-call mode of operation.
- C. Minimum Signal-to-Noise Ratio: 60 dB, at rated output.
- D. Frequency Response: Within plus or minus 2 dB from 50 to 12,000 Hz.

- E. Output Regulation: Maintains output level within 2 dB from full to no load.
- F. Input Sensitivity: Compatible with master stations and central equipment so amplifier delivers full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on master stations, speaker microphones, or handset transmitters.
- G. Amplifier Protection: Prevents damage from shorted or open output.

## 2.5 INTERCOMMUNICATION AMPLIFIER

- A. Minimum Output Power: 15 W; adequate for all functions.
- B. Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to one station connected to output terminals.
- C. Minimum Signal-to-Noise Ratio: 50 dB, at rated output.
- D. Frequency Response: Within plus or minus 3 dB from 70 to 10,000 Hz.
- E. Output Regulation: Maintains output level within 2 dB from full to no load.
- F. Input Sensitivity: Matched to input circuit and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on microphones in master stations, speaker microphones, or handset transmitters.
- G. Amplifier Protection: Prevents damage from shorted or open output.

## 2.6 PAGING AMPLIFIER

- A. Input Voltage: 120-V ac, 60 Hz.
- B. Frequency Response: Within plus or minus 3 dB from 60 to 10,000 Hz.
- C. Minimum Signal-to-Noise Ratio: 60 dB, at rated output.
- D. Total Harmonic Distortion: Less than 3 percent at rated output power from 70 to 12,000 Hz.
- E. Output Regulation: Less than 2 dB from full to no load.
- F. Controls: On-off, input levels, and low-cut filter.
- G. Input Sensitivity: Matched to input circuit and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on speaker microphones or handset transmitters.
- H. Amplifier Protection: Prevents damage from shorted or open output.

## 2.7 CONE-TYPE LOUDSPEAKERS/SPEAKER MICROPHONES

- A. Minimum Axial Sensitivity: 95 dB at one meter, with 1-W input.
- B. Frequency Response: Within plus or minus 3 dB from 70 to 17,000 Hz.

- C. Enclosures: Steel housing and front face with integral back box, acoustically dampened, and whole assembly with white baked acrylic enamel finish; complete with mounting assembly and suitable for lay-in ceiling mounting; with relief of back pressure.
- D. Baffle: 2-feet by 2-feet, perforated steel.
- E. Size: 8 inches with 3/4-inch voice coil and 5-oz. ceramic magnet.

## 2.8 HORN-TYPE LOUDSPEAKERS/SPEAKER MICROPHONES

- A. Speakers shall be high-impact ABS plastic, weatherproof construction; complete with universal mounting brackets.
- B. Frequency Response: Within plus or minus 3 dB from 225 to 14,000 Hz.
- C. Minimum Power Rating of Driver: 15 W, RMS.
- D. Minimum Dispersion Angle: 120 degrees horizontal and 90 degrees vertical.
- E. Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.

## 2.9 CONDUCTORS AND CABLES

- A. Conductors: Jacketed, twisted pair and twisted multipair, untinned solid copper. Sizes as recommended by system manufacturer, but no smaller than No. 22 AWG.
- B. Insulation: Thermoplastic, not less than 1/32 inch thick.
- C. Shielding: For speaker-microphone leads and elsewhere where recommended by manufacturer; No. 24 AWG, tinned, soft-copper strands formed into a braid or equivalent foil.
  - 1. Minimum Shielding Coverage on Conductors: 60 percent.

## PART 3 - EXECUTION

### 3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters, and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
  - 1. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.2 INSTALLATION OF RACEWAYS

- A. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits.
- B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

### 3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements:
  - 1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
  - 2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
  - 3. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
  - 5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
- C. Open-Cable Installation:
  - 1. Install cabling with horizontal and vertical cable guides in telecommunication spaces with terminating hardware and interconnection equipment.
  - 2. Suspend speaker cable not in a pathway a minimum of 8 inches above ceiling by cable supports not more than 60 inches apart.
  - 3. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
- D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

### 3.4 INSTALLATION

- A. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- B. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.
- C. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.5 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

### 3.6 SYSTEM PROGRAMMING

- A. Programming: Fully brief Owner on available programming options. Record Owner's decisions and set up initial system program. Prepare a written record of decisions, implementation methodology, and final results.

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Schedule tests with at least seven days' advance notice of test performance.
  - 2. After installing educational intercommunications and program systems and after electrical circuitry has been energized, test for compliance with requirements.
  - 3. Operational Test: Test originating station-to-station, all-call, and page messages at each intercommunication station. Verify proper routing and volume levels and that system is free of noise and distortion. Test each available message path from each station on system.
  - 4. Frequency Response Test: Determine frequency response of two transmission paths, including all-call and paging, by transmitting and recording audio tones. Minimum acceptable performance is within 3 dB from 150 to 2500 Hz.
  - 5. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
    - a. Disconnect speaker microphone and replace it in the circuit with a signal generator using a 1000-Hz signal. Measure signal-to-noise ratio at paging speakers.
    - b. Repeat test for three speaker microphones, one master station microphone, and for each separately controlled zone of paging loudspeakers.
    - c. Minimum acceptable ratio is 45 dB.
  - 6. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 150, 200, 400, 1000, and 2500 Hz into each intercom, paging, and all-call amplifier. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 5 percent total harmonics.
  - 7. Power Output Test: Measure electrical power output of each paging amplifier at normal gain settings of 150, 1000, and 2500 Hz. Maximum variation in power output at these frequencies is plus or minus 3 dB.
  - 8. Signal Ground Test: Measure and report ground resistance at system signal ground. Comply with testing requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

- C. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging and independent room speaker-line matching transformers.
- D. Educational intercommunications and program systems will be considered defective if they do not pass tests and inspections.

### 3.8 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
  - 2. Complete installation and startup checks according to manufacturer's written instructions.

### 3.9 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's administrative and maintenance personnel. The sessions shall facilitate the training of administrative personnel in operating classroom equipment, administrative equipment, program distribution, and user programming functions. System specific customized user manuals shall be provided at the time of training.
  - 1. Train Owner's maintenance personnel on programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining the system and equipment.

END OF SECTION 275123.50



## SECTION 275313 - CLOCK 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. Master clock and program control unit.
  - 2. Secondary indicating clocks.
  - 3. Program signal devices.
  - 4. Clock circuit power boosters.
  - 5. Interface with intercom system.
  - 6. System wire and cable.

## 1.3 DEFINITIONS

- A. NIST: The National Institute of Science and Technology.
- B. PC: Personal computer.
- C. UTC: Universal time coordinated. The precisely measured time at zero degrees longitude; a worldwide standard for time synchronization.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes (including available colors) for each product indicated and describe features and operating sequences, both automatic and manual, for the following:
  - 1. Master unit.
  - 2. Indicating clocks.
  - 3. Signal equipment.
  - 4. Equipment enclosures and back boxes.
  - 5. Accessory components.
- B. Shop Drawings: For clock systems. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring and correction circuits.
    - a. Identify terminals and wiring color codes to facilitate installation, operation, and maintenance.

- b. Indicate recommended wire types and sizes, and circuiting arrangements for field-installed system wiring. Show protection from overcurrent, static discharge, and voltage surge.
- C. Operation and Maintenance Data: For clock and program control 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, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.1 MASTER AND SECONDARY CLOCK SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Valcom V-GPS GPS Master Clock or comparable product by one of the following:
  - 1. American Time & Signal Co.
  - 2. Dukane Communication Systems; Part of GE Security, Inc.
  - 3. Rauland-Borg Corporation.
  - 4. Sapling, Inc.
- B. System Functions and Features:
  - 1. Supply power to remote indicating clocks.
  - 2. Maintain correct synchronized time and transmit time-correction signals over dedicated system wiring from a master clock to any one type of secondary indicating clocks, including the following:
    - a. Analog Synchronous Clocks: Correct for synchronization at least once each day.
  - 3. Initiate and execute programs for scheduled automatic operation of remote devices. Include audible signal devices.
  - 4. Provide for manual control of programmed signal and equipment-switching circuits.
  - 5. Regulate system timing functions using power-line frequency, backed up for power outages by an internal battery-powered, crystal-controlled oscillator, and automated periodic reference to NIST or UTC time signals via internal modem and network or microcomputer Internet access. Reference time signals shall be automatically accessed at programmable intervals.
  - 6. Provide for programming multiple independent event schedules into memory and running them simultaneously for different output circuits.
    - a. Quantity of Programmable Schedules: Eight, minimum.
    - b. Number of Weekly Events That Can Be Programmed for Each Schedule: 64, minimum.
    - c. Simultaneous operation of independent schedules shall be limited only by the number of signal-device and equipment-switching output circuits.
    - d. Advance Programming for Automatic Holiday Schedule Changes: Number of schedule changes that can be programmed to suit holidays and vacations shall be 50, and each change may be programmed up to a year in advance to occur on any day of the calendar year.

7. Provide programming for automatic daylight savings time correction.
8. Provide for adjustments to master clock output signals. Duration of momentary signal shall be individually programmable for each signal and equipment-control output circuit from 1 to 99 seconds. Signals shall be programmable for either on or off switching to suit equipment-operation scheduling.

## 2.2 MASTER CLOCK

- A. Description: Microprocessor-based, software-controlled unit complying with Class A device requirements in 47 CFR 15.
1. Programming and control switches.
  2. Informational Display: LED or backlit LCD type.
    - a. Normally shows current time display.
    - b. Provides programming cues when system is being programmed.
  3. Output Circuits for Power and Correction of Secondary Indicating Clocks:
    - a. Wired Synchronous Clock Power-and-Correction Circuits: For analog clocks; a minimum of two required. Relay controlled.
  4. Circuits for Audible Signal Devices: Relay controlled, manually switchable, using controls on the master clock. Rated 120-V ac, five A minimum. A minimum of eight circuits.
  5. Circuits for Programmable Switching of Remote Equipment and Circuits: Relay controlled, manually switchable, using controls on the master clock. Rated 120-V ac, 5 A minimum. A minimum of eight circuits.
  6. Power Supplies: Capacity for internal loads and power-and correction circuits of connected clocks.
  7. Housing: Rack-mounting metal enclosure with display indication visible on front panel face.
  8. Battery Backup for Time Base: Lithium battery to maintain the timekeeping function and retain the programs in memory during outage of normal ac power supply for up to 10 years.

## 2.3 SECONDARY INDICATING CLOCKS

- A. Analog Clock: Equipped with a sweep second hand. Movement shall be driven by self-starting, permanently lubricated, sealed synchronous motor equipped with a correcting solenoid actuator, or be a microprocessor-based, second impulse unit, compatible with the master clock.

## 2.4 PROGRAM SIGNAL DEVICES

- A. Loudspeakers for Audible Tones: See Division 27 Section "Educational Intercommunications and Program Systems."
- B. Outdoor Signal Equipment: Weatherproof models listed for outdoor use.
- C. Mounting Arrangement for Signal Devices: Designed for attachment with screws on the mounting plate of a flush-mounted back box unless otherwise indicated.
- D. Connection Provision for Signal-Indicating Devices: Wire pigtail or compression splice.

## 2.5 CLOCK CIRCUIT POWER BOOSTER

- A. Description: Transformer power supply, mounted in steel cabinet with hinged door, and having fuse-protected input and output circuits.

## 2.6 BACK BOXES FOR SECONDARY INDICATING CLOCKS AND PROGRAM DEVICES

- A. Description: Box and cover-plate assembly shall be furnished by device manufacturer and be suitable for device to be mounted. Back boxes shall be equipped with knockouts and hanger straps or mounting adapters arranged for flush mounting the device unless otherwise indicated.

## 2.7 GUARDS

- A. Description: Formed-steel wire, shaped to fit around guarded device, with 1-inch maximum clearance.
1. Mounting Provisions: Fixed tabs, welded to guard and arranged for screw attachment to mounting surface.
  2. Finish for Indoor Devices: Clear epoxy lacquer over zinc plating.

## 2.8 CONDUCTORS AND CABLES

- A. Conductors: Jacketed, twisted pair and twisted multipair, untinned solid copper. Sizes as recommended by system manufacturer, but not smaller than No. 22 AWG. Voltage drop for signal, control, and clock correction circuits shall not exceed 10 percent under peak load conditions. Comply with requirements in Division 27 Section "Communications Horizontal Cabling."
- B. 120-V AC and Class 1 Signal and Control Circuits: Stranded, single conductors of size and type recommended by system manufacturer. Materials and installation requirements are specified in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 2 and Class 3 Signal and Control Circuits: Single conductor or twisted-pair cable, unshielded, unless manufacturer recommends shielded cable.
- D. Data Circuits: Category 6 minimum, unshielded, twisted-pair cable, unless manufacturer recommends shielded cable.
- E. Insulation: Thermoplastic, not less than 1/32 inch thick.
- F. Conductor Color-Coding: Uniformly identified and coordinated with wiring diagrams.
- G. Shielding: For speaker-microphone leads and at other locations recommended by manufacturer; No. 34 AWG tinned, soft-copper strands formed into a braid or equivalent foil.
1. Minimum Shielding Coverage on Conductors: 60 percent.

## 2.9 PATHWAYS

- A. Intercommunication and Program System Raceways and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

- C. Flexible metal conduit is prohibited.

## PART 3 - EXECUTION

### 3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
  - 1. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

### 3.2 ELECTRICAL CONNECTIONS

- A. Make splices, taps, and terminations on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- B. Use splices for connections to clocks and signal devices.
- C. Ground clocks, programming equipment, and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

### 3.3 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
- B. Color-code wires, and apply wire and cable marking tape to designate wires and cables so they are uniformly identified and coordinated with wiring diagrams throughout the system.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installation, including connections.
- B. Tests and Inspections:
  - 1. Perform operational-system tests to verify compliance with the Specifications and make adjustments to bring system into compliance. Include operation of all modes of clock correction and all programming and manually programmed signal and relay operating functions.
  - 2. Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
- C. Clock system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Program system according to Owner's requirements. Set system so signal devices operate on Owner-required schedules and are activated for durations selected by Owner. Program equipment-control output circuits to suit Owner's operating schedule for equipment controlled.
- B. Adjust sound-output level of adjustable signal devices to suit Owner's requirements.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain clock-and-program-control system components.

END OF SECTION 275313

## SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

## 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. Electronic safety and security equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Sleeve seals.
  - 4. Common electronic safety and security installation requirements.

## 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

## 1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

## 1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## PART 2 - PRODUCTS

## 2.1 SLEEVES FOR RACEWAYS AND CABLES

- 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.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

## 2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: Plastic. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## PART 3 - EXECUTION

### 3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.2 SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

- A. Electronic safety and security penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.



- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- F. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- G. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- H. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- I. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### 3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 280500

## SECTION 281300 - ACCESS CONTROL

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. One or more security access networked workstations.
  - 2. Security access operating system and application software.
  - 3. Security access controllers connected to high-speed electronic-data transmission network.

## 1.3 DEFINITIONS

- A. CCTV: Closed-circuit television.
- B. CPU: Central processing unit.
- C. Credential: Data assigned to an entity and used to identify that entity.
- D. dpi: Dots per inch.
- E. DTS: Digital Termination Service. A microwave-based, line-of-sight communication provided directly to the end user.
- F. GFI: Ground fault interrupter.
- G. Identifier: A credential card; keypad personal identification number; or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- H. I/O: Input/Output.
- I. LAN: Local area network.
- J. Location: A Location on the network having a PC-to-controller communications link, with additional controllers at the Location connected to the PC-to-controller link with a TIA 485-A communications loop. Where this term is presented with an initial capital letter, this definition applies.
- K. PC: Personal computer. Applies to the central station, workstations, and file servers.
- L. PCI Bus: Peripheral Component Interconnect. A peripheral bus providing a high-speed data path between the CPU and the peripheral devices such as a monitor, disk drive, or network.

- M. PDF: Portable Document Format. The file format used by the Acrobat document-exchange-system software from Adobe.
- N. RAS: Remote access services.
- O. RF: Radio frequency.
- P. ROM: Read-only memory. ROM data are maintained through losses of power.
- Q. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- R. TWAIN: Technology without an Interesting Name. A programming interface that lets a graphics application, such as an image editing program or desktop publishing program, activate a scanner, frame grabber, or other image-capturing device.
- S. UPS: Uninterruptible power supply.
- T. USB: Universal serial bus.
- U. WAN: Wide area network.
- V. WAV: The digital audio format used in Microsoft Windows.
- W. WMP: Windows media player.
- X. Windows: Operating system by Microsoft Corporation.
- Y. Workstation: A PC with software that is configured for specific, limited security-system functions.
- Z. WYSIWYG: What You See Is What You Get. Text and graphics appear on the screen the same as they will in print.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Diagrams for cable management system.
  - 2. Wiring Diagrams. For power, signal, and control wiring. Show typical wiring schematics including the following:
    - a. Workstation outlets, jacks, and jack assemblies.
    - b. Patch cords.
    - c. Patch panels.
  - 3. Battery and charger calculations for central station, workstations, and controllers.
- C. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Microsoft Windows software documentation.

2. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.
3. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
4. System installation and setup guides with data forms to plan and record options and setup decisions.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
  1. Cable installer must have on staff a registered communication distribution designer certified by Building Industry Consulting Service International.
- B. Source Limitations: Obtain central station, workstations, controllers, Identifier readers, and all software through one source from single manufacturer.
- C. 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.
- D. Comply with NFPA 70, "National Electrical Code."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Central Station, Workstations, and Controllers:
  1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F, and not more than 80 percent relative humidity, noncondensing.
  2. Open each container; verify contents against packing list; and file copy of packing list, complete with container identification, for inclusion in operation and maintenance data.
  3. Mark packing list with the same designations assigned to materials and equipment for recording in the system labeling schedules that are generated by software specified in "Cable and Asset Management Software" Article.
  4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
  1. Control Station: Rated for continuous operation in ambient conditions of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
  2. Indoor, Controlled Environment: System components, except the central-station control unit, installed in temperature-controlled indoor environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.
  3. Outdoor Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of minus 30 to plus 122 deg F dry bulb and

20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 85 mph.

## PART 2 - RODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturer: Provide Lenel 32ES System to match Portland School District existing system.

### 2.2 DESCRIPTION

- A. System Software: Based on 32-bit, Microsoft Windows XP operation system central-station, workstation operating system, server operating system, and application software. Software shall have the following capabilities:
  - 1. Multiuser and multitasking to allow for independent activities and monitoring occurring simultaneously at different workstations.
  - 2. Graphical user interface to show pull-down menus and a menu-tree format that complies with interface guidelines of Microsoft Windows.
  - 3. System license for the entire system including capability for future additions that are within the indicated system size limits specified in this Section.
  - 4. Open-architecture system that allows importing and exporting of data and interfacing with other systems that are compatible with Microsoft Windows.
  - 5. Password-protected operator login and access.
  - 6. Open-database-connectivity compliant.
- B. Network connecting the central station and workstations shall be a LAN using Microsoft Windows-based TCP/IP with a capacity of connecting up to 99 workstations. System shall be portable across multiple communication platforms without changing system software.
- C. Network(s) connecting PCs and controllers shall consist of one or more of the following:
  - 1. Local area, IEEE 802.3 Fast Ethernet Gigabit-Ethernet, star topology network based on TCP/IP.
  - 2. Direct-connected, RS-232 cable from the COM port of the central station to the first controller, then RS-485 cable to interconnect the remaining controllers at that Location.

### 2.3 OPERATION

- A. Security access system shall use a single database for access-control and credential-creation functions.
- B. Distributed Processing: A fully distributed processing system.
  - 1. Access-control information, including time, date, valid codes, access levels, and similar data, shall be downloaded to controllers so each controller can make access-control decisions.
  - 2. In the event that communications with the central controller are lost, controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the central station.
- C. Number of Locations:

1. Support at least 32 separate Locations using a single PC with combinations of direct-connect, dial-up, or TCP/IP LAN connections to each Location.
  2. Each Location shall have its own database and history in the central station.
  3. Locations may be combined to share a common database.
- D. Data Capacity:
1. Unlimited different card-reader formats.
  2. 48 graphic file types for importing maps.
- E. Location Capacity:
1. 32 reader-controlled doors.
  2. 25,000 total-access credentials.
  3. Unlimited supervised alarm inputs.
  4. Unlimited programmable outputs.
- F. System Network Requirements:
1. System components shall be interconnected and shall provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
  2. Communication shall not require operator initiation or response and shall return to normal after partial- or total-network interruption such as power loss or transient upset.
  3. System shall automatically annunciate communication failures to the operator and shall identify the communications link that has experienced a partial or total failure.
- G. Field equipment shall include controllers, sensors, and controls.
1. Controllers shall serve as an interface between the central station and sensors and controls.
  2. Data exchange between the central station and the controllers shall include down-line transmission of commands, software, and databases to controllers.
  3. The up-line data exchange from the controller to the central station shall include status data such as intrusion alarms, status reports, and entry-control records.
  4. Controllers are classified as alarm-annunciation or entry-control type.
- H. System Response to Alarms:
1. Field device network shall provide a system end-to-end response time of one half-second or less for every device connected to the system.
  2. Alarms shall be annunciated at the central station within one half-second of the alarm occurring at a controller or at a device controlled by a local controller, and within 100 ms if the alarm occurs at the central station.
  3. Alarm and status changes shall be displayed within 100 ms after receipt of data by the central station.
  4. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within five seconds of alarm receipt at the security console.
  5. This response time shall be maintained during system heavy load.
- I. False-Alarm Reduction: The design of the central station and controllers shall contain features to reduce false alarms.
- J. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.

## K. Door Hardware Interface:

1. Comply with requirements in Division 08 Sections for door hardware required to be monitored or controlled by the security access system.
2. Electrical characteristics of controllers shall match the signal and power requirements of door hardware.

## 2.4 APPLICATION SOFTWARE

## A. System Software: Based on 32-bit, Microsoft Windows central-station and workstation operating system and application software.

1. Multiuser multitasking shall allow independent activities and monitoring to occur simultaneously at different workstations.
2. Graphical user interface shall show pull-down menus and a menu-tree format.
3. Capability for future additions within the indicated system size limits.
4. Open architecture that allows importing and exporting of data and interfacing with other systems that are compatible with operating system.
5. Password-protected operator login and access.

## B. Application Software: Interface between the alarm annunciation and entry-control controllers to monitor sensors and DTS links, operate displays, report alarms, generate reports, and help train system operators.

1. Reside at the central station, workstations, and controllers as required to perform specified functions.
2. Operate and manage peripheral devices.
3. Manage files for disk I/O, including creating, deleting, and copying files; and automatically maintain a directory of all files, including size and location of each sequential and random-ordered record.
4. Import custom icons into graphics to represent alarms and I/O devices.
5. Globally code I/O links so that any access-granted event can link to any I/O with the same Location without requiring interaction with the host PC. This operation shall be at the controller.
6. Messages from PC to controllers and controllers to controllers shall be on a polled network that utilizes check summing and acknowledgment of each message. Communication shall be automatically verified, buffered, and retransmitted if message is not acknowledged.
7. Selectable poll frequency and message time-out settings shall handle bandwidth and latency issues for TCP/IP, RF, and other PC-to-controller communications methods by changing the polling frequency and the amount of time the system waits for a response.
8. Automatic and encrypted backups for database and history backups shall be automatically stored at a selected workstation and encrypted with a nine-character alphanumeric password that must be used to restore or read data contained in backup.
9. Operator audit trail for recording and reporting all changes made to database and system software.
10. Support network protocol and topology, TCP/IP, Novel Netware, Digital Pathworks, Banyan Vines, LAN/WAN, and RAS.

## C. Workstation Software:

1. Password levels shall be individually customized at each workstation to allow or disallow operator access to program functions for each Location.
2. Workstation event filtering shall allow user to define events and alarms that will be displayed at each workstation. If an alarm is unacknowledged (not handled by another workstation) for a preset amount of time, the alarm will automatically appear on the filtered workstation.

## D. Controller Software:

1. Controllers shall operate as autonomous, intelligent processing units.
  - a. Controllers shall make decisions about access control, alarm monitoring, linking functions, and door-locking schedules for their operation, independent of other system components.
  - b. Controllers shall be part of a fully distributed processing-control network.
  - c. The portion of the database associated with a controller, and consisting of parameters, constraints, and the latest value or status of points connected to that controller, shall be maintained in the controller.
2. The following functions shall be fully implemented and operational within each controller:
  - a. Monitoring inputs.
  - b. Controlling outputs.
  - c. Automatically reporting alarms to the central station.
  - d. Reporting of sensor and output status to the central station on request.
  - e. Maintaining real time, automatically updated by the central station at least once a day.
  - f. Communicating with the central station.
  - g. Executing controller resident programs.
  - h. Diagnosing.
  - i. Downloading and uploading data to and from the central station.
3. Individual Controller Operation:
  - a. Controllers shall transmit alarms, status changes, and other data to the central station when communications circuits are operable. If communications are not available, controllers shall function in a stand-alone mode; operational data, including the status and alarm data normally transmitted to the central station, shall be stored for later transmission to the central station. Storage capacity for the latest 1024 events shall be provided at each controller.
  - b. Card-reader ports of a controller shall be custom configurable for an unlimited number of different card-reader or keypad formats. Multiple reader or keypad formats may be used simultaneously at different controllers or within the same controller.
  - c. Controllers shall provide a response to card readers or keypad entries in less than 0.5 seconds, regardless of system size.
  - d. Controllers that are reset, or powered up from a nonpowered state, shall automatically request a parameter download and reboot to their proper working state. This shall happen without any operator intervention.
  - e. Initial Startup: When controllers are brought on-line, database parameters shall be automatically downloaded to them. After initial download is completed, only database changes shall be downloaded to each controller.
  - f. On failure for any reason, controllers shall perform an orderly shutdown and force controller outputs to a predetermined failure-mode state, consistent with the failure modes shown and the associated control device.
  - g. After power is restored, following a power failure, startup software shall initiate self-test diagnostic routines, after which controllers shall resume normal operation.
  - h. After controller failure, if the database and application software are no longer resident, controllers shall not restart but shall remain in the failure mode until repaired. If database and application programs are resident, controllers shall immediately resume operation. If not, software shall be restored automatically from the central station.
4. Communications Monitoring:
  - a. System shall monitor and report status of TIA 485-A communications loop of each Location.

E. Controller-to-Controller Communications:



1. TIA 485-A communications signal shall be regenerated at each controller.

F. Database Downloads:

1. All data transmissions from PCs to a Location, and between controllers at a Location, shall include a complete database checksum to check the integrity of the transmission. If the data checksum does not match, a full data download shall be automatically retransmitted.
2. If a controller is reset for any reason, it shall automatically request and receive a database download from the PC. The download shall restore data stored at the controller to their normal working state and shall take place with no operator intervention.
3. Software shall provide for setting downloads via dial-up connection to once per 24-hour period, with time selected by the operator.

G. Operator Interface:

1. Inputs in system shall have two icon representations, one for the normal state and one for the abnormal state.
2. When viewing and controlling inputs, displayed icons shall automatically change to the proper icon to display the current system state in real time. Icons shall also display the input's state, whether armed or bypassed, and if the input is in the armed or bypassed state due to a time zone or a manual command.
3. Outputs in system shall have two icon representations, one for the secure (locked) state and one for the open (unlocked) state.
4. Icons displaying status of the I/O points shall be constantly updated to show their current real-time condition without prompting by the operator.
5. The operator shall be able to scroll the list of I/Os and press the appropriate toolbar button, or right click, to command the system to perform the desired function.
6. Graphic maps or drawings containing inputs, outputs, and override groups shall include the following:
  - a. Database to import and store full-color maps or drawings and allow for input, output, and override group icons to be placed on maps.
  - b. Maps to provide real-time display animation and allow for control of points assigned to them.
  - c. System to allow inputs, outputs, and override groups to be placed on different maps.
  - d. Software to allow changing the order or priority in which maps will be displayed.
7. Override Groups Containing I/Os:
  - a. System shall incorporate override groups that provide the operator with the status and control over user-defined "sets" of I/Os with a single icon.
  - b. Icon shall change automatically to show the live summary status of points in that group.
  - c. Override group icon shall provide a method to manually control or set to time-zone points in the group.
  - d. Override group icon shall allow the expanding of the group to show icons representing the live status for each point in the group, individual control over each point, and the ability to compress the individual icons back into one summary icon.
8. Schedule Overrides of I/Os and Override Groups:
  - a. To accommodate temporary schedule changes that do not fall within the holiday parameters, the operator shall have the ability to override schedules individually for each input, output, or override group.
  - b. Each schedule shall be composed of a minimum of two dates with separate times for each date.

- c. The first time and date shall be assigned the override state that the point shall advance to when the time and date become current.
  - d. The second time and date shall be assigned the state that the point shall return to when the time and date become current.
9. Copy command in database shall allow for like data to be copied and then edited for specific requirements, to reduce redundant data entry.

H. Operator Access Control:

- 1. Control operator access to system controls through 32,000 password-protected operator levels. System operators and managers with appropriate password clearances shall be able to change operator levels for operators.
- 2. Three successive attempts by an operator to execute functions beyond their defined level during a 24-hour period shall initiate a software tamper alarm.
- 3. A minimum of 32,000 passwords shall be available with the system software. System shall display the operator's name or initials in the console's first field. System shall print the operator's name or initials, action, date, and time on the system printer at login and logoff.
- 4. The password shall not be displayed or printed.
- 5. Each password shall be definable and assignable for the following:
  - a. Selected commands to be usable.
  - b. Access to system software.
  - c. Access to application software.
  - d. Individual zones that are to be accessed.
  - e. Access to database.

I. Operator Commands:

- 1. Command Input: Plain-language words and acronyms shall allow operators to use the system without extensive training or data-processing backgrounds. System prompts shall be a word, a phrase, or an acronym.
- 2. Command inputs shall be acknowledged and processing shall start in not less than one seconds.
- 3. Tasks that are executed by operator's commands shall include the following:
  - a. Acknowledge Alarms: Used to acknowledge that the operator has observed the alarm message.
  - b. Place Zone in Access: Used to remotely disable intrusion-alarm circuits emanating from a specific zone. System shall be structured so that console operator cannot disable tamper circuits.
  - c. Place Zone in Secure: Used to remotely activate intrusion-alarm circuits emanating from a specific zone.
  - d. System Test: Allows the operator to initiate a system-wide operational test.
  - e. Zone Test: Allows the operator to initiate an operational test for a specific zone.
  - f. Print reports.
  - g. Change Operator: Used for changing operators.
  - h. Security Lighting Controls: Allows the operator to remotely turn on or turn off security lights.
  - i. Display Graphics: Used to show any graphic displays implemented in the system. Graphic displays shall be completed within 20 seconds from time of operator command.
  - j. Run system tests.
  - k. Generate and format reports.
  - l. Request help with the system operation.

- 1) Include in main menus.

- 2) Provide unique, descriptive, context-sensitive help for selections and functions with the press of one function key.
- 3) Provide navigation to specific topic from within the first help window.
- 4) Help shall be accessible outside the application program.

m. Entry-Control Commands:

- 1) Lock (secure) or unlock (open) each controlled entry and exit up to 16 times a day through time-zone programming.
- 2) Arm or disarm each monitored input up to 16 times a day through time-zone programming.
- 3) Enable or disable readers or keypads up to 16 times a day through time-zone programming.
- 4) Enable or disable cards or codes up to 16 times a day per entry point through access-level programming.

J. Alarms:

1. System Setup:

- a. Assign manual and automatic responses to incoming-point status change or alarms.
  - b. Automatically respond to input with a link to other inputs, outputs, or operator-response plans; unique sound with use of WAV files; and maps or images that graphically represent the point location.
  - c. Sixty-character message field for each alarm.
  - d. Operator-response-action messages shall allow message length of at least 65,000 characters, with database storage capacity of up to 32,000 messages. Setup shall assign messages to access point.
  - e. Secondary messages shall be assignable by the operator for printing to provide further information and shall be editable by the operator.
  - f. Allow 25 secondary messages with a field of four lines of 60 characters each.
  - g. Store the most recent 1000 alarms for recall by the operator using the report generator.
2. Read access to system transcript files shall be reserved for operators with the highest password authorization level available in system.
  3. Animated Response Graphics: Highlight alarms with flashing icons on graphic maps; display and constantly update the current status of alarm inputs and outputs in real time through animated icons.
  4. Multimedia Alarm Annunciation: WAV files to be associated with alarm events for audio annunciation or instructions.
  5. Alarm Handling: Each input may be configured so that an alarm cannot be cleared unless it has returned to normal, with options of requiring the operator to enter a Comment about disposition of alarm. Allow operator to silence alarm sound when alarm is acknowledged.
  6. CCTV Alarm Interface: Allow commands to be sent to CCTV systems during alarms (or input change of state) through serial ports.

K. Alarm Monitoring: Monitor sensors, controllers, and DTS circuits and notify operators of an alarm condition. Display higher-priority alarms first and, within alarm priorities, display the oldest unacknowledged alarm first. Operator acknowledgment of one alarm shall not be considered acknowledgment of other alarms nor shall it inhibit reporting of subsequent alarms.

1. Displayed alarm data shall include type of alarm, location of alarm, and secondary alarm messages.
2. Printed alarm data shall include type of alarm, location of alarm, date and time (to nearest second) of occurrence, and operator responses.

3. Maps shall automatically display the alarm condition for each input assigned to that map if that option is selected for that input location.
  4. Alarms initiate a status of "pending" and require the following two handling steps by operators:
    - a. First Operator Step: "Acknowledged." This action shall silence sounds associated with the alarm. The alarm remains in the system "Acknowledged" but "Un-Resolved."
    - b. Second Operator Step: Operators enter the resolution or operator Comment, giving the disposition of the alarm event. The alarm shall then clear.
  5. Each workstation shall display the total pending alarms and total unresolved alarms.
  6. Each alarm point shall be programmable to disallow the resolution of alarms until the alarm point has returned to its normal state.
  7. Alarms shall transmit to the central station in real time except for allowing connection time for dial-up locations.
  8. Alarms shall be displayed and managed from a minimum of four different windows.
    - a. Input Status Window: Overlay status icon with a large red blinking icon. Selecting the icon will acknowledge the alarm.
    - b. History Log Transaction Window: Display name, time, and date in red text. Selecting red text will acknowledge the alarm.
    - c. Alarm Log Transaction Window: Display name, time, and date in red. Selecting red text will acknowledge the alarm.
    - d. Graphic Map Display: Display a steady colored icon representing each alarm input location. Change icon to flashing red when the alarm occurs. Change icon from flashing red to steady red when the alarm is acknowledged.
  9. Once an alarm is acknowledged, the operator shall be prompted to enter Comments about the nature of the alarm and actions taken. Operator's Comments may be manually entered or selected from a programmed predefined list, or a combination of both.
  10. For locations where there are regular alarm occurrences, provide programmed Comments. Selecting that Comment shall clear the alarm.
  11. The time and name of the operator who acknowledged and resolved the alarm shall be recorded in the database.
  12. Identical alarms from the same alarm point shall be acknowledged at the same time the operator acknowledges the first alarm. Identical alarms shall be resolved when the first alarm is resolved.
  13. Alarm functions shall have priority over downloading, retrieving, and updating database from workstations and controllers.
  14. When a reader-controlled output (relay) is opened, the corresponding alarm point shall be automatically bypassed.
- L. Monitor Display: Display text and graphic maps that include zone status integrated into the display. Colors are used for the various components and current data. Colors shall be uniform throughout the system.
1. Graphics:
    - a. Support 32,000 graphic display maps and allow import of maps from a minimum of 16 standard formats from another drawing or graphics program.
    - b. Allow I/O to be placed on graphic maps by the drag-and-drop method.
    - c. Operators shall be able to view the inputs, outputs, and the point's name by moving the mouse cursor over the point on the graphic map.
    - d. Inputs or outputs may be placed on multiple graphic maps. The operator shall be able to toggle to view graphic maps associated with I/Os.
    - e. Each graphic map shall have a display-order sequence number associated with it to provide a predetermined order when toggled to different views.

- f. Camera icons shall have the ability to be placed on graphic maps that, when selected by an operator, will open a video window, display the camera associated with that icon, and provide pan-tilt-zoom control.
  - g. Input, output, or camera placed on a map shall allow the ability to arm or bypass an input, open or secure an output, or control the pan-tilt-zoom function of the selected camera.
- M. System test software enables operators to initiate a test of the entire system or of a particular portion of the system.
- 1. Test Report: The results of each test shall be stored for future display or printout. The report shall document the operational status of system components.
- N. Report-Generator Software: Include commands to generate reports for displaying, printing, and storing on disk and tape. Reports shall be stored by type, date, and time. Report printing shall be the lowest-priority activity. Report-generation mode shall be operator selectable but set up initially as periodic, automatic, or on request. Include time and date printed and the name of operator generating the report. Report formats may be configured by operators.
- 1. Automatic Printing: Setup shall specify, modify, or inhibit the report to be generated; the time the initial report is to be generated; the time interval between reports; the end of the period; and the default printer.
  - 2. Printing on Request: An operator may request a printout of any report.
  - 3. Alarm Reports: Reporting shall be automatic as initially set up. Include alarms recorded by system over the selected time and information about the type of alarm (such as door alarm, intrusion alarm, tamper alarm, etc.), the type of sensor, the location, the time, and the action taken.
  - 4. Access and Secure Reports: Document zones placed in access, the time placed in access, and the time placed in secure mode.
  - 5. Custom Reports: Reports tailored to exact requirements of who, what, when, and where. As an option, custom report formats may be stored for future printing.
  - 6. Automatic History Reports: Named, saved, and scheduled for automatic generation.
  - 7. Cardholder Reports: Include data, or selected parts of the data, as well as the ability to be sorted by name, card number, imprinted number, or by any of the user-defined fields.
  - 8. Cardholder by Reader Reports: Based on who has access to a specific reader or group of readers by selecting the readers from a list.
  - 9. Cardholder by Access-Level Reports: Display everyone that has been assigned to the specified access level.
  - 10. Who Is "In" (Muster) Report:
    - a. Emergency Muster Report: One-click operation on toolbar launches report.
    - b. Cardholder Report. Contain a count of persons who are "In" at a selected Location and a detailed listing of name, date, and time of last use, sorted by the last reader used or by the group assignment.
  - 11. Panel Labels Reports: Printout of control-panel field documentation including the actual location of equipment, programming parameters, and wiring identification. Maintain system installation data within system database so that data are available on-site at all times.
  - 12. Activity and Alarm On-Line Printing: Activity printers for use at workstations; prints all events, or alarms only.
  - 13. History Reports: Custom reports that allow the operator to select any date, time, event type, device, output, input, operator, Location, name, or cardholder to be included or excluded from the report.
    - a. Initially store history on the hard disk of the host PC.
    - b. Permit viewing of the history on workstations or print history to any system printer.
    - c. The report shall be definable by a range of dates and times with the ability to have a daily start and stop time over a given date range.

- d. Each report shall depict the date, time, event type, event description, and device; or I/O name, cardholder group assignment, and cardholder name or code number.
- e. Each line of a printed report shall be numbered to ensure that the integrity of the report has not been compromised.
- f. Total number of lines of the report shall be given at the end of the report. If the report is run for a single event such as "Alarms," the total shall reflect how many alarms occurred during that period.

14. Reports shall have the following four options:

- a. View on screen.
- b. Print to system printer. Include automatic print spooling and "Print To" options if more than one printer is connected to the system.
- c. "Save to File" with full path statement.
- d. System shall have the ability to produce a report indicating status of system inputs and outputs or of inputs and outputs that are abnormal, out of time zone, manually overridden, not reporting, or in alarm.

15. Custom Code List Subroutine: Allow the access codes of system to be sorted and printed according to the following criteria:

- a. Active, inactive, or future activate or deactivate.
- b. Code number, name, or imprinted card number.
- c. Group, Location access levels.
- d. Start and stop code range.
- e. Codes that have not been used since a selectable number of days.
- f. In, out, or either status.
- g. Codes with trace designation.

16. The reports of system database shall allow options so that every data field may be printed.

17. The reports of system database shall be constructed so that the actual position of the printed data shall closely match the position of the data on the data-entry windows.

O. Visitor Assignment:

1. Provide for and allow an operator to be restricted to only working with visitors. The visitor badging subsystem shall assign credentials and enroll visitors. Allow only those access levels that have been designated as approved for visitors.
2. Provide an automated log of visitor name, time and doors accessed, and name of person contacted.
3. Allow a visitor designation to be assigned to a credential holder.
4. Security access system shall be able to restrict the access levels that may be assigned to credentials issued to visitors.
5. Allow operator to recall visitors' credential-holder file once a visitor is enrolled in the system.
6. The operator may designate any reader as one that deactivates the credential after use at that reader. The history log shall show the return of the credential.
7. System shall have the ability to use the visitor designation in searches and reports. Reports shall be able to print all or any visitor activity.

P. Time and Attendance:

1. Time and attendance reporting shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length designated in the report.
2. Shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length designated in the report.

3. System software setup shall allow designation of selected access-control readers as time and attendance hardware to gather the clock-in and clock-out times of the users at these readers.
  - a. Reports shall show in and out times for each day, total time in for each day, and a total time in for period specified by the user.
  - b. Allow the operator to view and print the reports, or save the reports to a file.
  - c. Alphabetically sort reports on the person's last name, by Location or location group. Include all credential holders or optionally select individual credential holders for the report.
- Q. Training Software: Enables operators to practice system operation, including alarm acknowledgment, alarm assessment, response force deployment, and response force communications. System shall continue normal operation during training exercises and shall terminate exercises when an alarm signal is received at the console.

## 2.5 SYSTEM DATABASE

- A. Database and database management software shall define and modify each point in database using operator commands. Definition shall include parameters and constraints associated with each system device.
- B. Database Operations:
  1. System data management shall be in a hierarchical menu-tree format, with navigation through expandable menu branches and manipulated with use of menus and icons in a main menu and system toolbar.
  2. Navigational Aids:
    - a. Toolbar icons for add, delete, copy, print, capture image, activate, deactivate, and muster report.
    - b. Point and click feature to facilitate data manipulation.
    - c. Next and previous command buttons visible when editing database fields to facilitate navigation from one record to the next.
    - d. Copy command and copy tool in the toolbar to copy data from one record to create a new similar record.
  3. Data entry shall be automatically checked for duplicate and illegal data and shall be verified for valid format.
  4. System shall generate a memo or note field for each item that is stored in database, allowing the storing of information about any defining characteristics of the item. Memo field is used for noting the purpose for which the item was entered, reasons for changes that were made, and the like.
- C. File Management:
  1. File management shall include database backup and restoration system, allowing selection of storage media, including Zip and Jaz drives, and designated network resources.
  2. Operations shall be both manual and automatic modes. The number of automatic sequential backups before the oldest backup will be overwritten; FIFO mode shall be operator selectable.
  3. Backup program shall provide manual operation from any PC on the LAN and shall operate while system remains operational.
- D. Operator Passwords:

1. Support up to 32,000 individual system operators, each with a unique password.
  2. The system shall support the use of strong passwords.
  3. Allow passwords to be case sensitive.
  4. Passwords shall not be displayed when entered.
  5. Passwords shall have unique and customizable password profile, and allow several operators to share a password profile. Include the following features in the password profile:
    - a. Predetermine the highest-level password profile for access to all functions and areas of program.
    - b. Allow or disallow operator access to any program operation, including the functions of View, Add, Edit, and Delete.
    - c. Restrict doors to which an operator can assign access.
  6. Operators shall use a user name and password to log on to system. This user name and password shall be used to access database areas and programs as determined by the associated profile.
  7. Make provision to allow the operator to log off without fully exiting program. User may be logged off but program will remain running while displaying the login window for the next operator.
- E. Access Card Operation and Management: Access authorization shall be by card.
1. Access authorization shall verify the facility code first, the card validation second, and the access level (time of day, day of week, date), anti-passback status, and number of uses last.
  2. Use data-entry windows to view, edit, and issue access levels. Access-authorization entry-management system shall maintain and coordinate all access levels to prevent duplication or the incorrect creation of levels.
  3. Allow assignment of up to 32 access levels for each Location to a cardholder. Each access level may contain any combination of doors.
  4. Each door may be assigned four time zones.
  5. Software shall allow the grouping of locations so cardholder data can be shared by all locations in the group.
  6. Visitor Access: Issue a visitor badge for data tracking or photo ID purposes without assigning that person a card or code.
  7. Allow each cardholder to be given either an unlimited number of uses or a number from one to 9999 that regulates the number of times the card can be used before it is automatically deactivated.
  8. Provide for cards and codes to be activated and deactivated manually or automatically by date. Provide for multiple deactivate dates to be preprogrammed.
- F. Security Access Integration:
1. Photo ID badging and photo verification shall use the same database as the security access and may query data from cardholder, group, and other personal information to build a custom ID badge.
  2. Automatic or manual image recall and manual access based on photo verification shall also be a means of access verification and entry.
  3. System shall allow sorting of cardholders together by group or other characteristic for a fast and efficient method of reporting on, and enabling or disabling, cards.
- G. Facility Codes: System shall accommodate up to 2048 facility codes per Location, with the option of allowing facility codes to work at all doors or only at particular doors.
- H. Group:



1. Group names may be used to sort cardholders into groups that allow the operator to determine the tenant, vendor, contractor, department, division, or any other designation of a group to which the person belongs.
2. System software shall have the capacity to assign one of an unlimited number of group names to an access authorization.
3. Make provision in software to deactivate and reactivate all access authorizations assigned to a particular group.
4. Allow sorting of history reports and code list printouts by group name.

I. Time Zones:

1. Each zone consists of a start and stop time for seven days of the week and eight holiday schedules. A time zone is assigned to inputs, outputs, or access levels to determine when an input shall automatically arm or disarm, when an output automatically opens or secures, or when access authorization assigned to an access level will be denied or granted.
2. Up to six time zones may be assigned to inputs and outputs to allow up to six arm or disarm periods per day or six lock or unlock periods per day; up to eight holiday override schedules may be assigned to a time zone.
3. Data-entry window shall display a dynamically linked bar graph showing active and inactive times for each day and holiday, as start and stop times are entered or edited.
4. System shall have the capacity for 255 time zones for each Location.

J. Holidays:

1. Eight different holiday schedules may be assigned to a time zone. Holiday schedule consists of date in format MM/DD/YYYY and a description. When the holiday date matches the current date of the time zone, the holiday schedule replaces the time-zone schedule for that 24-hour period.
2. The system shall support Holiday Ranges that shall allow a single holiday to span across multiple calendar days.
3. System shall have the capacity for 255 holidays.
4. Eight separate holiday schedules may be applied to a time zone.
5. Holidays have an option to be designated as occurring on the designated date each year. These holidays remain in the system and will not be purged.
6. Holidays not designated to occur each year shall be automatically purged from the database after the date expires.

K. Access Levels:

1. System shall allow for the creation of up to 32,000 access levels.
2. One level shall be predefined as the Master Access Level. The Master Access Level shall work at all doors at all times and override any anti-passback.
3. System shall allow for access to be restricted to any area by reader and by time. Access levels shall determine when and where an Identifier is authorized.
4. System shall be able to create multiple door and time-zone combinations under the same access level so that an Identifier may be valid during different time periods at different readers even if the readers are on the same controller.

L. Code Tracing:

1. System shall perform code tracing selectable by cardholder and by reader.
2. Any code may be designated as a "traced code" with no limit to how many codes can be traced.
3. Any reader may be designated as a "trace reader" with no limit to which or how many readers can be used for code tracing.
4. When a traced code is used at a trace reader, the access-granted message that usually appears on the monitor window of the central station shall be highlighted with a different color than regular

messages. A short singular beep shall occur at the same time the highlighted message is displayed on the window.

5. The traced cardholder image (if image exists) shall appear on workstations when used at a trace reader.

## 2.6 SURGE AND TAMPER PROTECTION

- A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.
- B. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display shall identify tamper alarms and indicate locations.

## 2.7 STANDARD WORKSTATION HARDWARE

- A. Workstation shall consist of a standard unmodified PC with accessories and peripherals that configure the workstation for a specific duty.
- B. Workstation Computer: Standard unmodified PC of modular design.
  1. Minimum requirements:
    - a. Pentium 4 Processor 2.8 GHz
    - b. 120/220V 200 Watts
    - c. 512 MB ECC RDRAM
    - d. 1MB cache
    - e. 24X CD ROM
    - f. 40GB SATA 7200 rpm hard drive
    - g. 10/100/1000 WuOL Ethernet communication
    - h. One serial port
    - i. One parallel port
    - j. Eight USB 2.0 ports
    - k. 17-inch Flat LCD Monitor
    - l. 64MB Video
    - m. Audio with speakers
    - n. USB keyboard
    - o. USB optical mouse with surge suppression strip
    - p. 3 year limited warranty.

## 2.8 FIXED MAP DISPLAY

- A. A fixed map display shall show layout of the protected facilities. Zones corresponding to those monitored by the system shall be highlighted on the display. Status of each zone shall be displayed using digital displays as required within each designated zone. A digital display test switch shall be provided on the map display.

## 2.9 CONTROLLERS

- A. Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the central station or workstation for controlling its operation.
- B. Battery Backup: Sealed, lead acid; sized to provide run time during a power outage of 90 minutes, complying with UL 924.
- C. Alarm Annunciation Controller:
  - 1. The controller shall automatically restore communication within 10 seconds after an interruption with the field device network.
    - a. Inputs: Monitor dry contacts for changes of state that reflect alarm conditions. Provides at least eight alarm inputs, which are suitable for wiring as normally open or normally closed contacts for alarm conditions.
    - b. Alarm-Line Supervision:
      - 1) Supervise the alarm lines by monitoring each circuit for changes or disturbances in the signal by monitoring for abnormal open, grounded, or shorted conditions using dc change measurements. System shall initiate an alarm in response to an abnormal current for longer than 500 ms.
      - 2) Transmit alarm-line-supervision alarm to the central station during the next interrogation cycle after the abnormal current condition.
    - c. Outputs: Managed by central-station software.
- D. Entry-Control Controller:
  - 1. Function: Provide local entry-control functions including one- and two-way communications with access-control devices such as card readers.
    - a. Operate as a stand-alone portal controller using the downloaded database during periods of communication loss between the controller and the field-device network.
    - b. Accept information generated by the entry-control devices; automatically process this information to determine valid identification of the individual present at the portal:
      - 1) On authentication of the credentials or information presented, check privileges of the identified individual, allowing only those actions granted as privileges.
      - 2) Privileges shall include, but are not limited to, time of day control, day of week control, group control, and visitor escort control.
    - c. Maintain a date-, time-, and Location-stamped record of each transaction. A transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.
  - 2. Inputs:
    - a. Data from entry-control devices; use this input to change modes between access and secure.
    - b. Database downloads and updates from the central station that include enrollment and privilege information.
  - 3. Outputs:

- a. Indicate success or failure of attempts to use entry-control devices and make comparisons of presented information with stored identification information.
  - b. Grant or deny entry by sending control signals to portal-control devices.
  - c. Maintain a date-, time-, and Location-stamped record of each transaction and transmit transaction records to the central station.
  - d. Door Prop Alarm: If a portal is held open for longer than 20 seconds, alarm sounds.
4. With power supplies sufficient to power at voltage and frequency required for field devices and portal-control devices.
5. Data Line Problems: For periods of loss of communication with the central station, or when data transmission is degraded and generating continuous checksum errors, the controller shall continue to control entry by accepting identifying information, making authentication decisions, checking privileges, and controlling portal-control devices.
- a. Store up to 100,000 transactions during periods of communication loss between the controller and access-control devices for subsequent upload to the central station on restoration of communication.
6. Controller Power: NFPA 70, Class II power-supply transformer, with 12- or 24-V ac secondary, backup battery and charger.
- a. Backup Power-Supply Capacity: UPS battery with capacity for a 24 hour duration.
  - b. Power Monitoring: Provide manual, dynamic battery-load test, initiated and monitored at the control center; with automatic disconnection of the controller when battery voltage drops below controller limits. Report by using local controller-mounted digital displays and by communicating status to central station. Indicate normal power on and battery charger on trickle charge. Indicate and report the following:
    - 1) Trouble Alarm: Normal power-off load assumed by battery.
    - 2) Trouble Alarm: Low battery.
    - 3) Alarm: Power off.

## 2.10 CARD READERS

- A. Card-Reader Power: Powered from its associated controller, including its standby power source, and shall not dissipate more than 1 W.
- B. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the controller. Response time shall be 800 ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.
- C. Enclosure: Suitable for surface mounting. Mounting types shall be suitable for installation indoors and outdoors.
- D. Display: Digital visual indicator shall provide visible and audible status indications and user prompts. Indicate power on or off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.
- E. Proximity Readers:
  - 1. Passive-detection proximity card readers shall use a swept-frequency, RF field generator to read the resonant frequencies of tuned circuits laminated into compatible credential cards. The resonant frequencies read shall constitute a unique identification code number.

2. The card reader shall read proximity cards in a range from direct contact to at least 6 inches from the reader.

## 2.11 ENROLLMENT CENTER

- A. Equipment for enrolling personnel into, and removing personnel from, system database, using a dedicated workstation PC, equal to the standard workstation described above.
- B. Enrollment equipment shall support encoding of credential cards including cryptographic and other internal security checks as required for system.
  1. Allow only authorized entry-control enrollment personnel to access the enrollment equipment using passwords.
  2. Include enrollment-subsystem configuration controls and electronic diagnostic aids for subsystem setup and troubleshooting with the central station.
  3. Enrollment-station records printer shall meet requirements of the report printer.
- C. Entry-Control Enrollment Software:
  1. Shall include database management functions for the system, and shall allow an operator to change and modify the data entered in the system as needed.
  2. Software shall not have alarm response or acknowledgment functions as a programmable function.
  3. Multiple, password-protected access levels shall be provided at the enrollment station.
  4. Database management and modification functions shall require a higher operator-access level than personnel enrollment functions.
  5. Software shall provide a means for disabling the enrollment station when it is unattended, to prevent unauthorized use.
  6. Software shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations to include a credential unit in use at the installation.
  7. Software shall allow entry of this data into the system database files through the use of simple menu selections and data fields. The data field names shall be customized to suit user and site needs.
- D. System Capacity: Number of badges shall be limited only by hard disk space. Badge templates and images shall be in color, supporting the maximum color capability of Microsoft Windows.
- E. Badge Configuration:
  1. Software for badge template creation shall include a template consisting of background and predetermined locations of photographs, text objects and data fields for text, and bar-code. Include automatic sizing of data fields placed on a badge to compensate for names, which may otherwise be too large to fit in the area designated.
  2. Allow different badge templates to be used for administration, staff, or visitor.
  3. As a setup option, templates shall be automatically selected for the badge, based on the group to which the credential holder is assigned. Allow the operator to override the automatic template selection and use a template chosen by the operator for creating a badge.
  4. Setup shall determine which graphics and credential-holder information will be displayed and where on the card it will be placed. All data in the security access system, such as name, code, group, access level, and any of the 99 user-defined fields, shall be selectable, with the ability to place them anywhere on the card.
  5. System shall include an importing, filing, and recall system of stored images and shapes that can be placed on the badge.
  6. Allow multiple images on the same badge, including, but not limited to, bar codes, digital photos, and signatures.

7. Support transparent backgrounds so that image is only surrounded by the intended background and not by its immediate background.
- F. Text Objects: Badge configuration shall provide for creation of custom text as an object, allowing font selection, typing, scaling, and formatting of the text object. Formatting options shall include changing font, font size, text flow, and text alignment; bending or curving the text object into a circle or semicircle; applying 3-D effects; and applying predefined effects such as tilt, extrusion, or beveling. Text shall be placed and optionally automatically centered within any region of the badge layout.
- G. Badges and Credential Cards:
1. Credential cards shall store uniquely coded data used by card readers as an Identifier.
    - a. Proximity Cards: Use proximity detection without physical contact with the reader for proper operation.
  2. Allow entry-control card to be modified by lamination or direct print process during the enrollment process for use as a picture and identification badge without reduction of readability. The design shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the type of badge holder used at the site.
    - a. Card Size and Dimensional Stability: Standard size, 2-1/8 by 3-3/8 inches; dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.
    - b. Card Material: Abrasion resistant, nonflammable, and nontoxic; and impervious to solar radiation and effects of ultraviolet light.
    - c. Card Construction: Core and laminate or monolithic construction. Lettering, logos, and other markings shall be hot stamped into the credential material or direct printed.
      - 1) Furnish equipment for on-site assembly and lamination of credential cards.
    - d. Card Durability and Maintainability: Designed and constructed to yield a useful lifetime of at least five years or 5000 insertions or swipes, whichever results in a longer period of time. Allow credential cards to be cleaned by wiping with a sponge or cloth wetted with soap and water.
- H. Card-Making Equipment: Consisting of a video camera, video-imaging equipment, and a printer.
1. Basis of Design: Lenel model CAM-20Z704-USB, plus printer described below.
  2. Camera: CCD NTSC camera with software zoom capabilities.
  3. Video Imaging: Real-time subject setup and scene adjustment.
  4. Synchronized cool white LED flash.
  5. Powered (telescoping) tripod stand.
  6. USB cable.
  7. Universal 110/220 VAC power supply.
  8. TWAIN device driver.
  9. Printer: Dye-sublimation resin thermal transfer, 300 dpi resolution, 16.7 million colors, accepting cards ranging in size from 2.1 by 3 inches to 2.6 by 3.7 inches and having card thickness ranging from 0.020 to 0.060 inch. Printer shall have options for encoding magnetic stripe using tracks 1, 2, and 3. Throughput shall be not less than 60 seconds per card.

## 2.12 TIA 232-F ASCII INTERFACE SPECIFICATIONS

- A. ASCII interface shall allow TIA 232-F connections to be made between the control station operating as the host PC and any equipment that will accept TIA 232-F ASCII command strings, such as CCTV switches.
  - 1. Alarm inputs in system shall allow for individual programming to output up to four unique ASCII character strings through two different COM ports on the host PC.
  - 2. Inputs shall have the ability to be defined to transmit a unique ASCII string for alarm and one for restore through one COM port, and a unique ASCII string for a nonalarm, abnormal condition and one for a normal condition through the same or different COM port.
  - 3. Predefined ASCII character strings shall have the ability to be up to 420 characters long with full use of all the ASCII control characters, such as return or line feed. Character strings shall be defined in the system database and then assigned to the appropriate inputs.
  - 4. COM ports of the host PC used to interface with external equipment shall be defined in the setup portion of the software. COM port's baud rate, word length, stop bits, and parity shall be definable in the software to match that of the external equipment.
  
- B. Alarm-System Interface:
  - 1. TIA 232-F output shall be capable of transmitting alarms from other monitoring and alarm systems to central-station automation software.
  - 2. Alternatively, alarms that are received by this access-control system are to be transferred to the alarm automation system as if they were sent through a digital alarm receiver.
    - a. System shall be able to transmit an individual message from any alarm input to a burglar-alarm automation monitoring system.
    - b. System shall be able to append to each message a predefined set of character strings as a prefix and a suffix.

## 2.13 CABLES

- A. General Cable Requirements: Comply with requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security" and as recommended by system manufacturer for integration requirement.
- B. PVC-Jacketed, TIA 485-A Cables: Two pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.
- C. LAN Cabling:
  - 1. Comply with requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security."
  - 2. NFPA 262.

## 2.14 TRANSFORMERS

- A. NFPA 70, Class II control transformers, NRTL listed. Transformers for security access-control system shall not be shared with any other system.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN and control cable conduit systems to PCs, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Comply with recommendations in SIA CP-01.
- B. Comply with TIA/EIA 606-A, "Administration Standard for Commercial Telecommunications Infrastructure."
- C. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

### 3.3 CABLING

- A. Comply with NECA 1, "Good Workmanship in Electrical Construction."
- B. Install cables and wiring according to requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security."
- C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
- D. Install LAN cables using techniques, practices, and methods that are consistent with Category 6 rating of components and fiber-optic rating of components, and that ensure Category 6 and fiber-optic performance of completed and linked signal paths, end to end.
- E. Boxes and enclosures containing security-system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.

### 3.4 CABLE APPLICATION

- A. Comply with TIA 569-B, "Commercial Building Standard for Telecommunications Pathways and Spaces."
- B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.
- C. TIA 485-A Cabling: Install at a maximum distance of 4000 ft.
- D. Card Readers and Keypads:



1. Install number of conductor pairs recommended by manufacturer for the functions specified.
2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from controller to the reader is 250 ft., and install No. 20 AWG wire if maximum distance is 500 ft.
3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the controller.
4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.

E. Install minimum No. 16 AWG cable from controller to electrically powered locks. Do not exceed 250 ft.

### 3.5 GROUNDING

A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."

C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

D. Bond shields and drain conductors to ground at only one point in each circuit.

E. Signal Ground:

1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
2. Bus: Mount on wall of main equipment room with standoff insulators.
3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

### 3.6 INSTALLATION

A. Install card readers.

### 3.7 IDENTIFICATION

A. In addition to requirements in this article, comply with applicable requirements in Division 26 Section "Identification for Electrical Systems" and with TIA/EIA 606-A.

B. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.

C. At completion, cable and asset management software shall reflect as-built conditions.

### 3.8 SYSTEM SOFTWARE AND HARDWARE

A. Develop, install, and test software and hardware, and perform database tests for the complete and proper operation of systems involved. Assign software license to Owner.

### 3.9 FIELD QUALITY CONTROL

#### A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

#### B. Tests and Inspections:

1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA 568-B.1, "Commercial Building Telecommunications Cabling Standards - Part 1: General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA 568-B.1.
2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power-supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

#### C. Devices and circuits will be considered defective if they do not pass tests and inspections.

#### D. Prepare test and inspection reports.

### 3.10 STARTUP SERVICE

#### A. Engage a factory-authorized service representative to supervise and assist with startup service.

1. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.
2. Enroll and prepare badges and access cards for Owner's administration, staff and maintenance personnel.

### 3.11 PROTECTION

- #### A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured with an activated burglar alarm and access-control system reporting to a central station complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.

### 3.12 DEMONSTRATION

- #### A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain security access system. See Division 01 Section "Demonstration and Training."

#### B. Develop separate training modules for the following:

1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
3. Maintenance personnel.
4. Administration.

END OF SECTION 281300

## SECTION 281600 - INTRUSION DETECTION

## 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. Intrusion detection with communication links to perform monitoring, alarm, and control functions.
2. Integration of other electronic and electrical systems and equipment.

## B. Related Sections:

1. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for cabling between master control units and field-mounted devices and control units.
2. Division 28 Section "Video Surveillance" for CCTV cameras.

## 1.3 DEFINITIONS

- A. CCTV: Closed-circuit television.
- B. PIR: Passive infrared.
- C. RFI: Radio-frequency interference.
- D. UPS: Uninterruptible power supply.
- E. Control Unit: System component that monitors inputs and controls outputs through various circuits.
- F. Master Control Unit: System component that accepts inputs from other control units and may also perform control-unit functions. The unit has limited capacity for the number of protected zones and is installed at an unattended location or at a location where it is not the attendant's primary function to monitor the security system.
- G. Monitoring Station: Facility that receives signals and has personnel in attendance at all times to respond to signals. A central station is a monitoring station that is listed.
- H. Protected Zone: A protected premises or an area within a protected premises that is provided with means to prevent an unwanted event.
- I. Standard Intruder: A person who weighs 100 lb or less and whose height is 60 inches or less; dressed in a long-sleeved shirt, slacks, and shoes.
- J. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.

- K. **Systems Integration:** The bringing together of components of several systems containing interacting components to achieve indicated functional operation of combined systems.
- L. **Zone.** A defined area within a protected premises. It is a space or area for which an intrusion must be detected and uniquely identified. The sensor or group of sensors must then be assigned to perform the detection, and any interface equipment between sensors and communication must link to master control unit.

#### 1.4 SUBMITTALS

- A. **Product Data:** Components for sensing, detecting, systems integration, and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. **Shop Drawings:** Detail assemblies of standard components that are custom assembled for specific application on this Project.
  - 1. **Functional Block Diagram:** Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate methods used to achieve systems integration. Indicate control, signal, and data communication paths and identify control interface devices and media to be used. Describe characteristics of network and other data communication lines.
    - a. Indicate methods used to achieve systems integration.
    - b. Indicate control, signal, and data communication paths and identify PLCs, networks, control interface devices, and media to be used.
    - c. Describe characteristics of network and other data communication lines.
    - d. Describe methods used to protect against power outages and transient voltages including types and ratings of isolation and surge suppression devices used in data, communication, signal, control, and ac and dc power circuits.
  - 2. **UPS:** Sizing calculations.
  - 3. **Device Address List:** Coordinate with final system programming.
  - 4. **System Wiring Diagrams:** Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
  - 5. **Details of surge-protection devices and their installation.**
  - 6. **Sensor detection patterns and adjustment ranges.**
- C. **Equipment and System Operation Description:** Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.
- D. **Qualification Data:** For intrusion detection systems integrator.
- E. **Operation and Maintenance Data:** For intrusion detection system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Data for each type of product, including features and operating sequences, both automatic and manual.
  - 2. Master control-unit hardware and software data.
- F. **Warranty:** Sample of special warranty.

## 1.5 QUALITY ASSURANCE

### A. Installer Qualifications:

1. An employer of workers, at least one of whom is a technician certified by the National Burglar & Fire Alarm Association.
2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

### B. Intrusion Detection Systems Integrator Qualifications: An experienced intrusion detection equipment supplier who has completed systems integration work for installations 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. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

### D. 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.

### E. Control Units, Devices, and Communications with Monitoring Station: Listed and labeled by a qualified testing agency for compliance with SIA CP-01.

### F. Comply with NFPA 70.

## 1.6 PROJECT CONDITIONS

### A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Master Control Unit: Rated for continuous operation in an ambient of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
2. Interior, Controlled Environment: System components, except master control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambients of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.
3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambients of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Comply with UL 294 and UL 639 for outdoor-use equipment. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph.

## 1.7 WARRANTY

### A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.

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

## 1.8 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. Intrusion Detection Devices: Furnish quantity equal to five percent of the number of units of each type installed, but no fewer than one of each type.

## PART 2 - PRODUCTS

### 2.1 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. Description: Hard-wired, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.
- B. Supervision: System components shall be continuously monitored for normal, alarm, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.
  - 1. Alarm Signal: Display at master control unit and actuate audible and visual alarm devices.
  - 2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or control-unit failure.
- C. System Control: Master control unit shall directly monitor intrusion detection units and connecting wiring.
- D. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.
- E. Operator Commands:
  - 1. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
  - 2. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
  - 3. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.
  - 4. System Test: Initiate system-wide operational test.
- F. Timed Control at Master Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.
- G. Response Time: Two seconds between actuation of any alarm and its indication at master control unit.
- H. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from master control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at master control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.
- I. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.

- J. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

## 2.2 SYSTEM COMPONENT REQUIREMENTS

- A. Compatibility: Detection devices and their communication features, connecting wiring, and master control unit shall be selected and configured with accessories for full compatibility with the following equipment:
  - 1. Door hardware specified in Division 08 Section "Door Hardware."
  - 2. Access control system specified in Division 28 Section "Access Control."
  - 3. Video surveillance system specified in Division 28 Section "Video Surveillance."
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
- C. Intrusion Detection Units: Listed and labeled by a qualified testing agency for compliance with UL 639.
- D. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V rms injected into power supply lines at 10 to 10,000 MHz.
- E. Tamper Protection: Tamper switches on detection devices, control units, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Master control-unit alarm display shall identify tamper alarms and indicate locations.
- F. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to master control unit.

## 2.3 ENCLOSURES

- A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.
- B. Interior Electronics: NEMA 250, Type 12.
- C. Screw Covers: Where enclosures are readily accessible, secure with security fasteners of type appropriate for enclosure.

## 2.4 SECURE AND ACCESS DEVICES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Bosch Security Systems D8229 access pad or comparable product by one of the following:
  - 1. Detection Systems, Inc.
  - 2. Honeywell International Inc.; Honeywell Security.
- B. Keypad and Display Module: Arranged for entering and executing commands for system-status changes and for displaying system-status and command-related data.



## 2.5 PIR SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Bosch Security Systems DS934 or comparable product by one of the following:
  - 1. Detection Systems, Inc.
  - 2. Honeywell International Inc.; Honeywell Security.
- B. Listed and labeled by a qualified testing agency for compliance with UL 639.
- C. Description: Sensors detect intrusion by monitoring infrared wavelengths emitted from a human body within their protected zone and by being insensitive to general thermal variations.
  - 1. Wall-Mounted Unit Maximum Detection Range: 125 percent of indicated distance for individual units and not less than 35 feet. Provide adjustable coverage pattern.
- D. Device Performance:
  - 1. Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F or less, and standard-intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps across two adjacent segments of detector's field of view.
  - 2. Test Indicator: LED test indicator that is not visible during normal operation. When visible, indicator shall light when sensor detects an intruder. Locate test enabling switch under sensor housing cover.
  - 3. Remote Test: When initiated by master control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

## 2.6 MASTER CONTROL UNIT

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Bosch Security Systems D7412G control panel or comparable product by one of the following:
  - 1. Detection Systems, Inc.
  - 2. Honeywell International Inc.; Honeywell Security.
- B. Description: Supervise sensors and detection subsystems and their connecting communication links, status control (secure or access) of sensors and detector subsystems, activation of alarms and supervisory and trouble signals, and other indicated functions.
  - 1. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
  - 2. Include a real-time clock for time annotation of events on the event recorder and printer.
  - 3. Addressable initiation devices that communicate device identity and status.
  - 4. Control circuits for operation of mechanical equipment in response to an alarm.
- C. Comply with UL 609.
- D. Console Controls and Displays: Arranged for interface between human operator at master control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
  2. Control-Unit Network: Automatic communication of alarm, status changes, commands, and other communications required for system operation. Communication shall return to normal after partial or total network interruption such as power loss or transient event. Total or partial signaling network failures shall identify the failure and record the failure at the annunciator display and at the system printer.
  3. Field Device Network: Communicate between the control unit and field devices of the system. Communications shall consist of alarm, network status, and status and control of field-mounted processors. Each field-mounted device shall be interrogated during each interrogation cycle.
  4. Operator Controls: Manual switches and push-to-test buttons that do not require a key to operate. Prevent resetting of alarm, supervisory, or trouble signals while alarm or trouble condition persists. Include the following:
    - a. Acknowledge alarm.
    - b. Silence alarm.
    - c. System reset.
    - d. LED test.
  5. Timing Unit: Solid state, programmable, 365 days.
  6. Confirmation: Relays, contactors, and other control devices shall have auxiliary contacts that provide confirmation signals to system for their on or off status. Software shall interpret such signals, display equipment status, and initiate failure signals.
  7. Alarm Indication: Audible signal sounds and a plain-language identification of the addressable detector originating the alarm appears on LCD display at master control unit.
  8. Alarm activation sounds a bell.
- E. Protected Zones: Quantity of alarm and supervisory zones as indicated, with capacity for expanding number of protected zones by a minimum of 25 percent.
- F. Power Supply Circuits: Master control units shall provide power for remote power-consuming detection devices. Circuit capacity shall be adequate for at least a 25 percent increase in load.
- G. UPS: UPS shall be sized to provide a minimum of six hours of master control-unit operation.
- H. Cabinet: Lockable, steel enclosure arranged so operations required for testing, normal operation, and maintenance are performed from front of enclosure. Accommodate all components and allow ample gutter space for field wiring. Identify enclosure by an engraved, laminated, phenolic-resin nameplate. Lettering on enclosure nameplate shall not be less than 1 inch high. Identify, with permanent labels, individual components and modules within cabinets.
- I. Transmission to Monitoring Station: A communications device to automatically transmit alarm, supervisory, and trouble signals to the monitoring station, operating over a standard voice grade telephone leased line. Comply with UL 1635.
- 2.7 AUDIBLE AND VISUAL ALARM DEVICES
- A. Basis-of-Design Product: Subject to compliance with requirements, provide Bosch Security Systems MB-G10-24-R or comparable product by one of the following:
1. Cooper Wheelock.
  2. Honeywell International Inc.; Honeywell Security.
- B. Bell: 6 inches in diameter, rated to produce a minimum sound output of 92 dB at 10 feet.

1. Enclosure: Weather-resistant back box equipped with tamper switches.

## 2.8 SECURITY FASTENERS

- A. Operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.
- B. Drive System Types: Pinned Torx-Plus, pinned Torx, or pinned hex (Allen).
- C. Socket Flat Countersunk Head Fasteners:
  1. Heat-treated alloy steel, ASTM F 835.
- D. Protective Coatings for Heat-Treated Alloy Steel:
  1. Zinc chromate, ASTM F 1135, Grade 3 or Grade 4, for exterior applications and interior applications where indicated.
  2. Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of intrusion detection.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.
- D. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.
  1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.
  2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.
- E. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SYSTEM INTEGRATION

- A. Integrate intrusion detection system with the following systems and equipment:
  1. Electronic door hardware.

2. Access control.
3. Video surveillance.

### 3.3 SYSTEM INSTALLATION

- A. Comply with UL 681 and NFPA 731.
- B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.

### 3.4 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceways according to Division 26 Section "Raceway and Boxes for Electrical Systems," except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- C. Wires and Cables:
  1. Conductors: Size as recommended in writing by system manufacturer unless otherwise indicated.
  2. 120-V Power Wiring: Install according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
  3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable unless otherwise indicated or if manufacturer recommends shielded cable, according to Division 28 Section "Conductors and Cables for Electronic Safety and Security."
  4. Data and Television Signal Transmission Cables: Install according to Division 28 Section "Conductors and Cables for Electronic Safety and Security."
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- E. Install power supplies and other auxiliary components for detection devices at control units unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.
- F. Identify components with engraved, laminated-plastic or metal nameplate for master control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with identification requirements in Division 26 Section "Identification for Electrical Systems."
- B. Install instructions frame in a location visible from master control unit.

### 3.6 GROUNDING

- A. Ground the master control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to master control unit.
- B. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- C. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide 5-ohm ground. Measure, record, and report ground resistance.

### 3.7 FIELD QUALITY CONTROL

- A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
  - 1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections: Comply with provisions in NFPA 731, Ch. 9, "Testing and Inspections."
  - 1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
  - 2. Test Methods: Intrusion detection systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."
- E. Documentation: Comply with provisions in NFPA 731, Ch. 4, "Documentation."
- F. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

### 3.8 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose. Visits for this purpose shall be in addition to any required by warranty.

### 3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the intrusion detection system. Comply with documentation provisions in NFPA 731, Ch. 4, "Documentation and User Training."

END OF SECTION 281600

## SECTION 282300 - VIDEO SURVEILLANCE

## 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 a video surveillance system consisting of cameras, digital video recorder, data transmission wiring, and a control station with its associated equipment.
- B. Video surveillance system shall be integrated with monitoring and control system specified in Division 28 Sections "Intrusion Detection" and "Access Control," which specifies systems integration.

## 1.3 DEFINITIONS

- A. AGC: Automatic gain control.
- B. BNC: Bayonet Neill-Concelman - type of connector.
- C. CCD: Charge-coupled device.
- D. FTP: File transfer protocol.
- E. IP: Internet protocol.
- F. LAN: Local area network.
- G. MPEG: Moving picture experts group.
- H. NTSC: National Television System Committee.
- I. PC: Personal computer.
- J. PTZ: Pan-tilt-zoom.
- K. RAID: Redundant array of independent disks.
- L. TCP: Transmission control protocol - connects hosts on the Internet.
- M. UPS: Uninterruptible power supply.
- N. WAN: Wide area network.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
  - 3. UPS: Sizing calculations.
  - 4. Wiring Diagrams: For power, signal, and control wiring.
- C. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.
- D. Operation and Maintenance Data: For cameras, power supplies, monitors, videotape recorders, digital video switches, and control-station components to include in emergency, operation, and maintenance manuals.
- E. Warranty: Sample of special warranty.

#### 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.
- B. Comply with NECA 1.
- C. Comply with NFPA 70.
- D. Electronic data exchange between video surveillance system with an access-control system shall comply with SIA TVAC.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
  - 1. Interior, Controlled Environment: System components, except central-station control unit, installed in air-conditioned interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.
  - 2. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 4 to plus 122 deg F dry bulb and 20 to 80 percent relative humidity, non-condensing. Rate for continuous operation when exposed to rain, winds up to 85 mph and snow cover up to 24 inches thick. Use IP66 enclosures.

#### 1.7 WARRANTY



- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Three years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SYSTEM REQUIREMENTS

- A. Video-signal format shall comply with NTSC standard, composite interlaced video.
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.
- C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

### 2.2 REINFORCED DOME CAMERAS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Axis Communications 225FD network camera or a comparable product by another manufacturer.
- B. Camera: Designed for high-abuse locations, with a weathertight surface mounting, impact-resistance polycarbonate dome, and metal base.
  - 1. Suitable for exterior environment, rated for continuous operation in ambient temperatures of minus 4 to plus 122 deg F dry bulb and up to 8 percent relative humidity.
  - 2. Image Sensor: 1/4" Sony progressive scan RGB CCD.
  - 3. Lens: F1.4 varifocal 2.8 to 5.8 mm, DC-iris.
  - 4. Day & Night: Automatic IR filter removal in low light conditions.
  - 5. Minimum illumination:
    - a. Color mode: 1 lux at F1.4.
    - b. Black/white mode: 0.2 lux at F1.4.
  - 6. Video compression: Motion JPEG and MPEG-4 Part 2.
  - 7. Resolution: 640 x 480.
  - 8. Frame rate: Up to 30 fps at any resolution.
  - 9. Video Streaming:
    - a. Simultaneous Motion JPEG and MPEG-4.
    - b. Controllable frame rate and bandwidth.
    - c. Constant and variable bit rate (MPEG-4).
  - 10. Alarm and event management:
    - a. Events triggered by video motion detection, tampering detection, temperature limits, external inputs or according to a schedule.

- b. Image upload over FTP, email and HTTP.
- c. Notification over TCP, email, HTTP and external outputs.
- d. 9 MB of pre- and post-alarm buffer.

11. Power (when using built-in heater): 24 VDC, max 20 W, or 24 VAC, max 25 VA.

### 2.3 POWER SUPPLIES

A. Low-voltage power supplies matched for voltage and current requirements of cameras and accessories, and of type as recommended by manufacturer of camera when using built-in heater.

- 1. Axis PS12 with IP67 enclosure.

### 2.4 CAMERA-SUPPORTING EQUIPMENT

A. Basis-of-Design Product: Subject to compliance with requirements, provide Axis Communications #25736 gooseneck wall mount and #5502-001 pendant kit, or comparable product by one another manufacturer.

B. Minimum Load Rating: Rated for load in excess of the total weight supported times a minimum safety factor of two.

C. Mounting Brackets for Fixed Cameras: Type matched to items supported and mounting conditions. Include manual pan-and-tilt adjustment.

### 2.5 NETWORK VIDEO RECORDER / SERVER

A. Basis-of-Design Product: Subject to compliance with requirements, provide Lenel OnGuard® Network Video Recorder #LVNR to match the Portland School District's existing system.

- 1. Pentium IV 3.0 GHz processor.
- 2. 512 MB RAM, 256 KB Cache.
- 3. 19-inch rack mount, industrial chassis.
- 4. Supports one 80 GB OS Drive and up to eight 200 GB data hard drives.
  - a. Provide a minimum of 1 TB hard drive storage with initial install.
- 5. CD-ROM drive.
- 6. Operating System: Microsoft Windows XP.
- 7. 10/100/1000 Ethernet RJ-45.
- 8. Physical:
  - a. 120 Volts, 60 Hz, 6 Amps.
  - b. Redundant power supply: 350 Watts.
  - c. Nine hard drive bays accessible from front grill.
  - d. Nine cooling fans.

B. Video Recording:

- 1. Composite video input (NTSC).
- 2. Unlimited number of cameras associated with any alarm point.
- 3. View live and recorded video, while recording simultaneously.

4. Supports up to a maximum of 63 IP cameras.
5. Selectable 24/7, time-lapse, or event based recording modes.
6. Resolution: 640 x 480 (each camera).
7. Frame rate: Up to 30 fps (each camera).

C. Playback Capabilities:

1. Multiple user access to cameras.
2. Matrix view: 128fps in matrix view, unless limited by available bandwidth and workstation PC CPU.
3. Digital zoom.
4. Frame advance.
5. Still image capture and save.
6. Export video clips to .asf format.
7. Automatic motion video searching.
8. Video Image Processing.
9. Operator created events.

D. Monitoring Capabilities:

1. Live monitoring of each system camera.
2. Auto video window launch for triggered camera events.
3. Video player window resolution: scalable.
4. Digital zoom.
5. Still image capture and save.
6. Matrix view: 128fps in matrix view, unless limited by available bandwidth and workstation PC CPU.

## 2.6 IP VIDEO SYSTEMS

A. Description:

1. System shall provide high-quality delivery and processing of IP-based video, audio, and control data using standard Ethernet-based networks.
2. System shall have seamless integration of all video surveillance and control functions.
3. Graphical user interface software shall manage all IP-based video matrix switching and camera control functions, two-way audio communication, alarm monitoring and control, and recording and archive/retrieval management. IP system shall also be capable of integrating into larger system environments.
4. System design shall include all necessary compression software for high-performance, streaming MPEG-4 video. Unit shall provide connections for all video cameras, discreet sensor inputs, and control system outputs.
5. All camera signals shall be compressed, encoded, and delivered onto the network for processing and control by the IP video-management software.
6. Camera system units shall be ruggedly built and designed for extreme adverse environments, complying with NEMA Type environmental standards.
7. Encoder/decoder combinations shall place video and data network stream that can be managed from multiple workstations on the user's LAN or WAN.
8. All system interconnect cables, workstation PCs, and network intermediate devices shall be provided for full performance of specified system.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN, WAN, and IP network before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 WIRING

- A. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- C. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. For LAN connection and fiber-optic and copper communication wiring, comply with Division 27 Sections "Communications Backbone Cabling" and "Communications Horizontal Cabling."
- E. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

### 3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

- A. Install cameras and infrared illuminators level and plumb.
- B. Install cameras with 156-inch-minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.
- C. Install power supplies and other auxiliary components at control stations unless otherwise indicated.
- D. Install tamper switches on components, arranged to detect unauthorized entry into system-component enclosures and mounted in self-protected, inconspicuous positions.
- E. Avoid ground loops by making ground connections only at the control station.
- F. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:

1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
  2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:
    - a. Prepare equipment list described in "Submittals" Article.
    - b. Set and name all preset positions; consult Owner's personnel.
    - c. Connect and verify responses to alarms.
  3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
  4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
- C. Video surveillance system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:
1. Check cable connections.
  2. Check proper operation of cameras.
  3. Adjust all preset positions; consult Owner's personnel.
  4. Recommend changes to cameras and associated equipment to improve Owner's use of video surveillance system.
  5. Provide a written report of adjustments and recommendations.

### 3.6 CLEANING

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean video-surveillance-system components, including camera-housing windows and monitor screens.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

END OF SECTION 282300

## SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Fire-alarm control unit.
  - 2. Manual fire-alarm boxes.
  - 3. System smoke detectors.
  - 4. Heat detectors.
  - 5. Notification appliances.
  - 6. Remote annunciator.
  - 7. Digital alarm communicator transmitter.

## 1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

## 1.4 SYSTEM DESCRIPTION

- A. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
  - 2. Include voltage drop calculations for notification appliance circuits.
  - 3. Include battery-size calculations.

4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.

C. Qualification Data: For qualified Installer.

D. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," deliver copies to authorities having jurisdiction and include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
  - a. Frequency of testing of installed components.
  - b. Frequency of inspection of installed components.
  - c. Requirements and recommendations related to results of maintenance.
  - d. Manufacturer's user training manuals.
5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 25.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final checkout and to ensure the systems integrity.
- B. Source Limitations for Fire-Alarm System and Components: The FACP and peripheral devices shall be manufactured by a single manufacturer (or division thereof).
- C. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

#### 1.7 SOFTWARE MODIFICATIONS

- A. Comply with UL 864.
- B. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.
- C. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Gamewell-FCI E3 Series and compatible peripheral equipment to match the Portland School District's fire alarm systems.

## 2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings.

B. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 4 (Class B) Signaling Line Circuits (SLC).
2. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.
3. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.
4. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
5. NAC speaker circuits shall be arranged such that there is a minimum of one speaker circuit per smoke zone.
6. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.
7. NAC speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.
8. Two-way telephone communication circuits shall be supervised for open and short circuit conditions.

## 2.3 BASIC SYSTEM FUNCTIONAL OPERATION

- A. When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

1. The system alarm LED on the system display shall flash.
2. A local piezo electric signal in the control panel shall sound.
3. A backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
4. History storage equipment shall log the information associated with each new fire alarm control panel condition, along with time and date of occurrence.
5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciator.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Release fire and smoke doors held open by magnetic door holders.



5. Activate voice/alarm communication system.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Recall elevators to primary or alternate recall floors.
9. Activate emergency shutoffs for gas and fuel supplies.
10. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Fire-pump power failure, including a dead-phase or phase-reversal condition.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciator.

#### 2.4 FIRE-ALARM CONTROL UNIT

A. Basis of design for FACP shall be a Gamewell-FCI E3 Series® Classic and shall contain a microprocessor based Central Processing Unit (CPU) and power supply. The CPU shall communicate with and control the following types of equipment used to make up the system:

1. Intelligent addressable smoke detectors.
2. Intelligent addressable thermal (heat) detectors.
3. Addressable modules.
4. Annunciators.
5. Other system controlled devices.

B. Operator Control

1. Acknowledge Switch:

- a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition.
- b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

2. Alarm Silence Switch:

- a. Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.
3. Alarm Activate (Drill) Switch:
    - a. The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.
  4. System Reset Switch:
    - a. Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.
  5. Lamp Test:
    - a. The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.

C. System Capacity and General Operation

1. The control panel or each network node shall provide, or be capable of expansion to 636 intelligent/addressable devices.
2. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of 2.0 amps @ 30 VDC.
3. It shall also include four programmable Notification Appliance Circuits.
4. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status LEDs, and an alphanumeric keypad with touch keys for the field programming and control of the fire alarm system.
5. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
6. The system shall allow the programming of any input to activate any output or group of outputs. The FACP shall support up to 20 logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming. Logic equations shall require the use of a PC with a software utility designed for programming.
7. The FACP shall provide the following features:
  - a. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
  - b. Detector sensitivity test, meeting requirements of NFPA 72, Chapter 7.
  - c. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
  - d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be .5 to 2.35 percent per foot for photoelectric detectors.
  - e. The ability to display system reports.
  - f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
  - g. Periodic detector test, conducted automatically by the software

8. Network Communication: The FACP shall be capable of communicating on a Local Area Network (LAN).

D. Central Microprocessor

1. The microprocessor shall be a 16-bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage, Flash memory for building-specific program storage, and a "watch dog" timer circuit to detect and report microprocessor failure.
2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.
3. The microprocessor shall also provide a real-time clock for time annotation of system displays and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.

E. System Display

1. The display shall include an 80-character backlit alphanumeric Liquid Crystal Display (LCD), and a full PC style QWERTY keypad with the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.
2. The display shall include the following operator control switches:
  - a. ACKNOWLEDGE
  - b. ALARM SILENCE
  - c. ALARM ACTIVATE (drill)
  - d. SYSTEM RESET
  - e. LAMP TEST.
3. The display shall provide Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters:
  - a. AC POWER
  - b. FIRE ALARM
  - c. SUPERVISORY SIGNAL
  - d. SYSTEM TROUBLE
  - e. DISABLED POINTS
  - f. ALARM SILENCED
  - G. CONTROLS ACTIVE
  - H. PRE-DISCHARGE
  - I. DISCHARGE
  - J. ABORT
4. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.
5. The system shall support the display of battery charging current and voltage on the LCD display.

F. Signaling Line Circuits (SLC)

1. Each FACP shall support up to two SLCs. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (photoelectric or thermal) and 159 intelligent modules (monitor or control) for a loop capacity of 318 devices. The addition of the optional second loop shall double the device capacity, supporting a total of 636 devices.

2. CPU shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

#### G. Serial Interfaces

1. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting UL Listed Information Technology Equipment (ITE) peripherals.
  - a. One EIA-232 interface shall be used to connect a UL-listed CRT terminal. This interface shall include special protocol methods that allow off-site monitoring of the FACP over standard dial-up phone lines. This ancillary capability shall allow remote readout of all status information, including analog values, and shall not interfere with or degrade FACP operations when used. It shall allow remote FACP Acknowledge, Reset, or Signal Silence in this mode. It shall also allow adjustment of detector sensitivity and readout of the history file.
  - b. The system shall include an EIA-485 port for the serial connection of optional annunciators and remote LCD displays.
  - c. The EIA-485 interface may be used for network connection to a proprietary-receiving unit.

#### H. Voice Command Center (VCC)

1. The facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. A Message generator shall be capable of automatically distributing two simultaneous, unique messages to appropriate audio zones within the facility based on the type and location of the initiating event. The Fire Command Center (FCC) shall also support Emergency manual voice announcement capability for both system wide or selected audio zones, and shall include provisions for the system operator to override automatic messages system wide or in selected zones.
  - a. The digital audio message generator shall be of reliable, non-moving parts, and support the digital storage of at least 16 or 32 minutes of tones and emergency messages, shall support programming options to string audio segments together to create up to 1000 messages, or to loop messages and parts of messages to repeat for pre-determined cycles or indefinitely.
  - b. The audio portion of the system shall sound the proper audio signal (consisting of tone, voice, or tone and voice) to the appropriate zones.
  - c. Notification Appliance Circuits (NAC) speaker circuits shall be arranged such that there is a minimum of one speaker circuit per smoke zone.
  - d. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.
  - e. Speaker circuits shall be electrically supervised for open and short circuit conditions. If a short circuit exists on a speaker circuit, it shall not be possible to activate that circuit.
  - f. Speaker circuits shall be either 25 VRMS or 70VRMS. Speaker circuits shall have 20% space capacity for future expansion or increased power output requirements.

#### I. Enclosures:

1. The control panel shall be housed in a UL-listed cabinet suitable for surface mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.

3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be site configured for either right or left hand hinging.

J. Power Supply:

1. An off-line switching power supply shall be available for the fire alarm control panel and provide 6.0 amps of available power for the control panel and peripheral devices.
2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
3. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 55 AH or may be used with an external battery and charger system. Battery arrangement may be configured in the field.
4. The power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:
  - a. Ground Fault
  - b. AC Power Fail
  - c. NAC ON (4)
5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.
6. The main power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge and be capable of charging batteries up to 200 AH.
7. All circuits shall be power-limited, per UL864 requirements.

K. Auxiliary Addressable Power Supply

1. The auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24VDC power. The power supply shall also include and charge backup batteries.
2. The addressable power supply for the fire alarm system shall provide a minimum of 6.0 amps of 24 volt DC regulated power for Notification Appliance Circuit (NAC) power or 5 amps of 24 volt DC general power. The power supply shall have an additional 0.5 amp of 24 VDC auxiliary power for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 7.0 - 25.0 amp hour batteries.
3. The addressable power supply shall provide four individually addressable Notification Appliance Circuits. All circuits shall be power-limited per UL 864 requirements.
4. The addressable power supply shall provide built-in synchronization for Notification Appliances on each circuit without the need for additional synchronization modules.
5. The addressable power supply shall operate on 120 VAC, 60 Hz.
6. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire. Data on the SLC shall be transmitted between 24 VDC, 5 VDC and 0 VDC at approximately 3.33k baud.
7. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.
8. The addressable power supply mounts in either the FACP backbox or it's own dedicated surface mounted backbox with cover.
9. Each of the power supply's four output circuits shall be DIP-switch selected for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.
10. The addressable power supply's output circuits shall be individually supervised.

11. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.
12. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

L. Field Charging Power Supply (FCPS)

1. The FCPS is a device designed for use as either a remote 24-volt power supply or used to power Notification Appliances.
  - a. The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24-volt power. It shall include an integral charger designed to charge 7.0 amp hour batteries and to support a 60-hour standby.
  - b. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs shall be available for connection to the Notification devices.
  - c. The FCPS shall include a surface mount backbox.
  - d. The FCPS include power limited circuitry, per 1995 UL standards.

M. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 5 to 30 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
3. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.
4. Point Read: The system shall be able to display the following point status diagnostic functions:
  - a. Device status
  - b. Device type
  - c. Device label
  - d. Device zone assignments
  - e. All program parameters
5. System Status Reports: Upon command from an operator of the system, a status report will be generated, listing all system status.
6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Each of these activations will be stored and time and date stamped with the actual time of the activation. The history buffer shall use non-volatile memory.
7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware or tools to perform.

8. Software Zones: The FACP shall provide 100 software zones, 10 additional special function zones, 10 releasing zones, and 20 logic zones.
9. Waterflow Operation: An alarm from a waterflow detection device shall activate the appropriate alarm message on the main panel display, turn on all programmed notification appliance circuits and shall not be affected by the signal silence switch.
10. Supervisory Operation: An alarm from a supervisory device shall cause the appropriate indication on the system display, light a common supervisory LED, but will not cause the system to enter the trouble mode.
11. Signal Silence Operation: The FACP shall have the ability to program each output circuit (notification, relay, speaker etc.) to deactivate upon depression of the signal silence switch.
12. Non-Alarm Input Operation: Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.

N. Elevator Recall:

1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
  - a. Elevator lobby detectors except the lobby detector on the designated floor.
  - b. Smoke detector in elevator machine room.
2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.

O. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

P. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

## 2.5 MANUAL FIRE ALARM STATIONS

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions 0.5-inch in size or larger in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire alarm control unit. Units shall be equipped with key lock so that they may be tested without operating the handle.
2. Station Reset: Key-operated switch.

## 2.6 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.

3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
  - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
  - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
  - c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).
3. Each sensor shall have multiple levels of detection sensitivity.
4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
5. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

## 2.7 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.



- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
  - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.

## 2.8 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.
- B. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
  - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
  - 1. Rated Light Output:
    - a. 15/30/75/110 cd, selectable in the field.
  - 2. Mounting: Wall or ceiling-mounted.
  - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
  - 4. Flashing shall be in a temporal pattern, synchronized with other units.
  - 5. Strobe Leads: Factory connected to screw terminals.
  - 6. Mounting Faceplate: Factory finished, white.
- D. Voice/Tone Notification Appliances:
  - 1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
  - 2. Low-Range Units: Rated 1 to 2 W.
  - 3. Mounting: Flush.
  - 4. Matching Transformers: Tap range matched to acoustical environment of speaker location.

## 2.9 REMOTE ANNUNCIATOR

- A. The alphanumeric display annunciator shall be a supervised, remotely located backlit LCD display containing a minimum of 80 characters for alarm annunciation in clear English text.
- B. The LCD annunciator shall display all alarm and trouble conditions in the system.
- C. An audible indication of alarm shall be integral to the alphanumeric display.
- D. The display shall be UL listed for fire alarm application.
- E. Mounting: Surface cabinet, NEMA 250, Type 1.

## 2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER (DACT)

- A. Digital alarm communicator transmitter (DACT) shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. The DACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. The wire connections between the DACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status.
- C. The DACT shall include connections for dual telephone lines. It shall include the ability for split reporting of panel events to up to three different telephone numbers.
- D. The DACT shall be completely field programmable from a built-in keypad and display.
- E. The DACT shall be capable of transmitting events in at least 15 different formats to ensure compatibility with existing and future transmission formats.
- F. Communication shall include system status including, but not limited to:
  - 1. Independent Zone (Alarm, trouble, non-alarm, supervisory)
  - 2. Independent Addressable Device Status
  - 3. AC (Mains) Power Loss
  - 4. Low Battery and Earth Fault
  - 5. System Off Normal
  - 6. 12 and 24 Hour Test Signal
  - 7. Abnormal Test Signal
  - 8. EIA-485 Communications Failure
  - 9. Phone Line Failure
- G. The DACT shall support independent zone/point reporting when used in the Contact ID format. In this format the DACT shall support transmission of up to 2,040 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.
- H. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire alarm control unit and automatically capture two telephone lines and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- I. Local functions and display at the digital alarm communicator transmitter shall include the following:
  - 1. Verification that both telephone lines are available.
  - 2. Programming device.
  - 3. LED display.
  - 4. Manual test report function and manual transmission clear indication.
  - 5. Communications failure with the central station or fire-alarm control unit.

## 2.11 FIELD WIRING TERMINAL BLOCKS

- A. For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire.

## 2.12 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
  - 1. Factory fabricated and furnished by manufacturer of device.
  - 2. Finish: Paint of color to match the protected device.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
- C. Smoke- or Heat-Detector Spacing:
  - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
  - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
  - 3. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
  - 4. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
  - 5. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
- D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- E. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- F. Visible Alarm-Indicating Devices: Install adjacent to each audible alarm and at least 6 inches below the ceiling.
- G. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.
- H. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

### 3.2 CONDUIT AND WIRE

- A. Conduit:
  - 1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
  - 2. Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
  - 3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors.

4. Wiring for 24-volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
6. Conduit shall be 3/4-inch minimum.

B. Wire:

1. Wiring shall be in accordance with local, state and national codes and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for Initiating Device Circuits and Signaling Line Circuits, and 14 AWG for Notification Appliance Circuits.
2. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
3. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
4. Wiring used for the multiplex communication circuit (SLC) shall be twisted and unshielded and support a minimum wiring distance of 12,500 feet. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit.
5. All field wiring shall be electrically supervised for open circuit and ground fault.
6. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs).

C. Terminal Boxes, Junction Boxes and Cabinets:

1. All boxes and cabinets shall be UL listed for their use and purpose.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

E. The fire alarm control panel shall be connected to a separate dedicated 20-ampere branch circuit. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a water pipe or ground rod.

### 3.3 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
2. Smoke dampers in air ducts of designated air-conditioning duct systems.
3. Alarm-initiating connection to elevator recall system and components.
4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.

5. Supervisory connections at valve supervisory switches.
6. Supervisory connections at elevator shunt trip breaker.
7. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
8. Supervisory connections at fire-pump engine control panel.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

### 3.5 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire alarm control unit.

### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
  1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
    - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
  2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
  4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
  5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

## SECTION 311000 - SITE CLEARING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

## A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities as indicated on drawings.
7. Temporary erosion- and sedimentation-control measures.

## B. Related Sections:

1. Division 01 Section "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities.
2. Division 01 Section "Execution" for field engineering and surveying.
3. Division 01 Section(s) "**Construction Waste Management and Disposal and "Sustainable Design Requirements"**" for additional LEED requirements.
4. Division 02 Section "Structure Demolition" for demolition of buildings, structures, and site improvements.

## 1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. See Landscape Drawings and specifications for more information.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

#### 1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials, unless otherwise designated on the site drawings, shall become Contractor's property and shall be removed from Project site.

#### 1.5 SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
  - 1. Use sufficiently detailed photographs or videotape.
  - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

#### 1.6 QUALITY ASSURANCE

#### 1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing 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.
- B. Salvable Improvements: Carefully remove items, including trees, indicated to be salvaged and store on Owner's premises.
- C. Utility Locator Service: Notify **Dig Safe System** for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant protection measures are in place.
- E. The following practices are prohibited within protection zones:
  - 1. Storage of construction materials, debris, or excavated material.
  - 2. Parking vehicles or equipment.
  - 3. Foot traffic.
  - 4. Erection of sheds or structures.
  - 5. Impoundment of water.
  - 6. Excavation or other digging unless otherwise indicated.
  - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.



## PART 2 - PRODUCTS

## PART 3 - EXECUTION

## 3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain. See drawings.
- C. Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

## 3.2 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 erosion- and sedimentation-control. Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

## 3.3 TREE AND PLANT PROTECTION

- A. General: Protect trees and plants remaining on-site according to requirements in Division 01 Section "Temporary Tree and Plant Protection.", and on the project site and landscape drawings.
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by the design engineer, landscape architect and/or City of Portland arborist.

## 3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
  - 1. Arrange with utility companies to shut off indicated utilities.
- 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. Do not proceed with utility interruptions without Owner Representative's written permission.
- C. Excavate for and remove underground utilities indicated to be removed.

### 3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
  - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  - 2. Use only hand methods for grubbing within protection zones.
  - 3. Chip removed tree branches and stockpile in area approved by Owner Representative.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

### 3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
  - 1. Do not stockpile topsoil within protection zones.
  - 2. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
  - 3. Stockpile surplus topsoil to allow for respreading deeper topsoil.

### 3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
  - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

### 3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

## 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, including in particular, Section 018113 Sustainable Design Requirements.

## 1.2 SUMMARY

## A. Section Includes:

1. Preparing subgrades for slabs on grade, walks, pavements, turf and grasses, and plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase and base course for concrete plaza.
5. Subbase and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.
8. Excavating well hole to accommodate elevator-cylinder assembly.
9. Excavating and backfilling utility trenches.

## B. Related Sections:

1. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
2. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
3. Division 14 Section "Hydraulic Elevators" for excavating well hole to accommodate elevator-cylinder assembly.
4. Divisions 21, 22, 23, 26, 27, 28, and 33 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
5. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping, and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
6. Division 31 Section "Dewatering" for lowering and disposing of ground water during construction.
7. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
8. Division 32 Section "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
9. Division 32 Section "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.
10. Division 33 Section "Subdrainage" for drainage of foundations and bioretention beds.

## 1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices for earth moving specified in Division 01 Section "Unit Prices." Unit prices only apply to additional work not defined in the specifications and site drawings.

## 1.4 DEFINITIONS

- A. Aggregate Base Course: Course placed between the subbase course and hot-mix asphalt paving.
- B. Aggregate Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- C. 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.
- D. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- E. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- F. “Clean” as applied to soil materials means with no deleterious, non-specified material mixed with the specified soil. Soil material has not been contaminated during transport or installation with other soil material. In the case of manufactured soil material, the resulting soil material has been washed or otherwise treated to remove excess fines that are a result of the manufacturing process.
- G. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- H. 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 Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
  - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by engineer. Unauthorized excavation, as well as remedial work directed by engineer, shall be without additional compensation.
- I. Fill: Soil materials used to raise existing grades.
- J. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 2 cu.yd or more in volume that “cannot be excavated without drilling and blasting and drilling and splitting.” (from MDOT Standard Specifications, section 203.01)
- K. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

## 1.5 SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
  - 1. Geotextiles.
  - 2. Warning tapes.
- B. Qualification Data: For qualified testing agency.
- C. Material Test Reports: For each soil material proposed for fill and backfill as follows:
  - 1. Classification according to ASTM D 2487.
  - 2. Laboratory compaction curve according to ASTM D 1557.
- D. Blasting plan approved by authorities having jurisdiction
- E. Pre-excavation Photographs or Videotape: 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.
- F. Field Test Reports (Note - Reports shall be as specified herein and as per applicable ASTM Standards).
  - 1. All aggregate, granular fill tests/gradation report.
  - 2. Subsurface drains, granular fill tests
  - 3. Structural fill material tests/compaction report.
  - 4. Compaction tests
  - 5. General site fill/gradation report.
  - 6. Stone dust/gradation report
  - 7. As specified within this section.

## 1.6 QUALITY ASSURANCE

- A. Blasting: 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.
- D. Preexcavation Conference: Conduct conference at Project site.

## 1.7 PROJECT CONDITIONS

- A. 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.
- B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
  - 1. Do not proceed with work on adjoining property until directed by Engineer.
- C. Utility Locator Service: Notify Dig Safe System for area where Project is located before beginning earth moving operations.
- D. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 01 Section "Temporary Facilities and Controls," Division 31 Section "Site Clearing," are in place.
- E. Do not commence earth moving operations until plant-protection measures specified in Division 01 Section "Temporary Tree and Plant Protection", and on the project site and landscape drawings are in place.
- F. The following practices are prohibited within protection zones:
  - 1. Storage of construction materials, debris, or excavated material.
  - 2. Parking vehicles or equipment.
  - 3. Foot traffic.
  - 4. Erection of sheds or structures.
  - 5. Impoundment of water.
  - 6. Excavation or other digging unless otherwise indicated.
  - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- G. Do not direct vehicle or equipment exhaust towards protection zones.
- H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Unsatisfactory Soils: On-site soils are frost susceptible and are not suitable for re-use in the proposed building, access drives, parking areas, playing field, or for backfilling utility trenches.
  - 1. On-site soils may be suitable for reuse as common fill in landscaped areas with the approval of the designer. If contractor plans to reuse the native material on site, the material shall be segregated and stockpiled during construction. Suitability for reuse will depend on the grain size analysis,

gradation, and in-situ moisture content. The soil must have a moisture content acceptable for achieving project compaction requirements.

2. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

- C. Subbase Material: Aggregate for subbase shall be sand or gravel of hard durable particles free from vegetable matter, lumps, or balls of clay and other deleterious substances. Aggregate for subbase shall pass the 6 inch sieve 100%. The gradation of that that passes a 3 inch sieve shall meet the following grading requirements.

<u>Sieve Designation</u>	<u>Percent by weight passing square mesh sieves</u>
¼ in.	25-70
# 40	0-30
# 200	0-7.0

- D. Base Course: Aggregate for base shall be screened or crushed gravel of hard durable particles free from vegetable matter, lumps, or balls of clay and other deleterious substances. Type A base material shall pass the 2 inch square mesh sieve 100%. The gradation shall meet the following requirements.

<u>Sieve Designation</u>	<u>Percent by weight passing square mesh sieves</u>
½ in.	45-70
¼ in.	30-55
# 40	0-20
# 200	0-5.0

- E. Granular Fill: Provide a dense, graded aggregate meeting requirements stated in Section 703.06 Type B, MDOT State Standard and as follows:

1. The gradation of the part that passes a 3 inch sieve shall meet the following grading requirements:

<u>Sieve Designation</u>	<u>Percent by Weight Passing square mesh sieves</u>
1/2 inch	35-75
1/4 inch	25-60
No. 40	0-25
No. 200	0-5

Granular fill shall not contain particles of rock that will not pass a 4 inch square mesh sieve.

- F. Structural Fill: Used to backfill foundations, below floor slabs, and below entrance slabs and sidewalks shall be clean, non-frost susceptible sand and gravel meeting the following gradation requirements.

<u>Sieve Designation</u>	<u>Percent by weight passing square mesh sieves</u>
4 in.	100
3 in.	90-100
¼ in.	25-90
# 40	0-30
# 200	0-5.0

- G. Subgrade fill/General Site Fill : Used to replace on-site unsuitable soils to raise building and pavement subgrades shall meet MDOT standard specifications 703.19, Granular Borrow.

- H. Stone Dust: Stone dust shall consist of clean, washed concrete sand or stone dust free from vegetable matter lumps or balls of clay and other deleterious substances conforming to the following gradation requirements:

<u>Sieve Designation</u>	<u>Percent by weight passing square mesh sieves</u>
3/8"	100
No. 4	90-96
No. 100	10-30

NOTE: Do not use mason sand or Limestone screenings.

- I. Crushed Stone/coarse aggregate: Clean material used around footing drains and as choke stone over fractured bedrock shall meet the following gradation.

<u>Sieve Designation</u>	<u>Percent by weight passing square mesh sieves</u>
1 in.	100
3/4 in.	90-100
3/8 in.	0-75
# 4	0-25
# 200	0-5.0

- J. Bio-retention bed underdrain material: Clean backfill material shall be granular material for Underdrain Type B shall be free from organic matter and shall meet the following gradation.

<u>Sieve Designation</u>	<u>Percent by weight passing square mesh sieves</u>
1 in	90-100
1/2 in	75-100
# 4	50-100
# 20	15-80
# 50	0-15
# 200	0-2.0

- K. Recycled materials – brick, concrete, and asphalt – Contractor is encouraged to recycle or reuse salvaged construction materials on the site. Contractor shall submit to designer a plan for the reuse of such materials, grain size analysis, gradation, and moisture content, and proposed use. Manufactured recycled soil substitute materials shall meet the requirements for the proposed use. Costs for the removal, storage, manufacture and placement of these materials are included in the project.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: for protecting underdrain bedding material in footing and filtration bed drains. Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polypropylene; 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; ASTM D 4632.
3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
4. Tear Strength: 56 lbf; ASTM D 4533.
5. Puncture Strength: 56 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 70 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.5 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

- B. Separation Geotextile: for separation of construction soil material and unsuitable native soil material on the site. Woven geotextile fabric, manufactured for separation applications, made from polypropylene; 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; ASTM D 4632.
3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 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.

### 2.3 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils 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 wide and 4 mils 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 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.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Maintain tree and other plant material protection during earth moving operations and material storage on site.
- D. Protect subgrades and foundation soils from freezing temperatures and frost. Remove 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. See Section 312319 for more information.
- 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.

### 3.3 EXPLOSIVES

- A. Explosives: 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.

### 3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
  - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
  - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
    - a. 12 inches outside of concrete forms other than at footings.
    - b. 6 inches beneath and 12 inches of overexcavation (1H to 1V) beyond the sides of the footings.
    - c. Minimum 24 inches below bottom of slab
    - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
    - e. Minimum 24 inches beneath bottom of concrete slabs-on-grade and pavements.
    - f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

### 3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  - 1. Excavations for Footings and Foundations: "Foundation subgrade preparation consist(s) of over-excavating below all footings at least 6 inches and placing [and compacting] at least 6 inches of compacted [structural fill]...underlain by a woven geotextile for soil subgrades. For bedrock subgrades the crushed stone should be worked into fractures to fill any voids. The width of the Crushed Stone layer should extend at least 12 inches beyond the edges of the proposed footings

for each 12 inches of overexcavation.” (geotechnical report, S.W. Cole Engineering, Inc., May 30, 2008, p 7)

2. Floor Slabs: For soil subgrades excavate “at least 12 inches below bottom of slab elevation. [Place and compact] “at least 12 inches of Structural Fill” underlain by a woven geotextile. Where bedrock is encountered, “remove bedrock to at least 24 inches below bottom of slab. Where bedrock is removed to achieve subgrade elevations, a 4 to 6 inch thick layer of crushed stone should be worked into fractured bedrock prior to placing Granular Borrow” and at least 12 inches of Structural Fill. (geotechnical report, S.W. Cole Engineering, Inc., May 30, 2008, p 7)
3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection," and project landscaping drawings.

### 3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavations beneath the entire length and width of entrances, sidewalks, and exterior slabs adjacent to the building shall continue to at least 4.5 feet below finish grade. This area shall be backfilled with structural fill and shall transition up to adjacent walks or pavement subbase at a 3:1 slope or flatter.
- B. 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. Provide 2 layers of 2” rigid insulation if cover over pipe is less than 5’. See detail on project site drawings.
- 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 higher than top of pipe or conduit unless otherwise indicated.
  1. Clearance: As indicated on project site drawing details.
- C. Trench Bottoms: Excavate trenches 6 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
  1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trenches in Tree- and Plant-Protection Zones:
  1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection," and project landscape drawings.

### 3.8 EXCAVATION FOR ELEVATOR CYLINDER

- A. Drill well hole plumb in elevator pit to accommodate installation of elevator-cylinder assembly. Coordinate with applicable requirements for diameter and tolerances in Division 14 Section "Hydraulic Elevators."
- B. Provide well casing as necessary to retain walls of well hole.

### 3.9 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.
- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
  1. 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. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

### 3.10 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.
  1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

### 3.11 STORAGE OF SOIL MATERIALS

- A. Stockpile soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
  2. Stockpiles shall meet the requirements outlined on drawing C500 for slopes, seeding and mulching.

### 3.12 BACKFILL - GENERAL

- 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.

C. Granular Borrow (MDOT 703.19) shall be used to raise building and pavement area subgrades.

### 3.13 BACKFILL FOR STRUCTURES

A. Structural Fill shall be used to backfill foundations, below floor slabs and below entrance slabs. "The zone of non-frost susceptible material below entrance slabs and sidewalks should transition up to adjacent sidewalk or pavement subbase at a 3:1 slope or flatter." (geotechnical report, S.W. Cole Engineering, Inc., May 30, 2008, p 9)

B. "Exterior foundation backfill should be sealed with a surficial layer of ...loamy soil in areas that are not to be paved or occupied by entrance slabs...to reduce direct surface water infiltration into the backfill." (geotechnical report, S.W. Cole Engineering, Inc., May 30, 2008, p 8)

### 3.14 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. Trenches under Footings: Backfill trenches excavated under footings as specified on structural drawings and specifications, if applicable.

D. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than below surface of paved areas. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Place and compact initial backfill of Crushed Stone to a height of 12 inches 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.

G. Place and compact final backfill of Granular Borrow to final subgrade elevation.

H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### 3.15 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.

### 3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit density according ASTM D 1557:
  - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
  - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
  - 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
  - 4. For utility trenches, compact each layer of initial and final backfill soil material at 92 percent.

### 3.17 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 Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
  - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
  - 2. Walks: Plus or minus ½ inch.
  - 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of [1/2 inch] <Insert dimension> when tested with a 10-foot straightedge.

### 3.18 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase

subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

### 3.19 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
  - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
  - 2. Place base course material over subbase course under hot-mix asphalt pavement.
  - 3. Shape subbase course and base course to required crown elevations and cross-slope grades.
  - 4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
  - 5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches 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.

### 3.20 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
  - 2. Determine that fill material and maximum lift thickness comply with requirements.
  - 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections. Contractor is responsible for coordinating the scheduling of tests with the geotechnical engineering firm.
- C. 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.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- E. 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, unless amended by designer:
  - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft or less of paved area or building slab, but in no case fewer than three tests.
  - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.
  - 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.

- F. 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.

### 3.21 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
  - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
  - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### 3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
  - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000



## SECTION 312319 - DEWATERING

## 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, including in particular, Section 018113 Sustainable Design Requirements.

## 1.2 SUMMARY

- A. Section includes construction dewatering.
- B. Related Sections:
  - 1. Division 01 Section "Construction Progress Documentation" for recording preexisting conditions and dewatering system progress.
  - 2. Division 31 Section "Earth Moving" for excavating, backfilling, site grading, and for site utilities.
  - 3. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
  - 4. Division 33 Section "Subdrainage" for permanent footing drainage.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
  - 1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
  - 2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
  - 3. Prevent surface water from entering excavations by grading, dikes, or other means.
  - 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
  - 5. Remove dewatering system when no longer required for construction.

## 1.4 SUBMITTALS

- A. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
  - 1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
  - 2. Include a written plan for dewatering operations including control procedures to be adopted if dewatering problems arise.

- B. Delegated-Design Submittal: For dewatering system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Qualification Data: For qualified Installer.
- D. Field quality-control reports.
- E. Other Informational Submittals:
  - 1. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to dewatering including, but not limited to, the following:
    - a. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
    - b. Geotechnical report.
    - c. Proposed site clearing and excavations.
    - d. Existing utilities and subsurface conditions.
    - e. Coordination for interruption, shutoff, capping, and continuation of utility services.
    - f. Construction schedule. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - g. Testing and monitoring of dewatering system.

#### 1.6 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
  - 1. Notify Architect no fewer than two days in advance of proposed interruption of utility.
  - 2. Do not proceed with interruption of utility without Architect's written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
  - 1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
  - 2. The geotechnical report is included and referenced elsewhere in the Project Manual.

- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
  - 1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

## PART 2 - PRODUCTS (Not Used)

## 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 dewatering operations.
  - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
  - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Monitor dewatering systems continuously.
- E. Promptly repair damages to adjacent facilities caused by dewatering.
- F. Protect and maintain temporary erosion and sedimentation controls, which are specified in Division 01 Section "Temporary Facilities and Controls" Division 31 Section "Site Clearing", and on the Project Erosion and Sedimentation Control drawing, during dewatering operations.

### 3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
  - 1. Space well points or wells at intervals required to provide sufficient dewatering.
  - 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

- C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
  - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
- D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
  - 1. Maintain piezometric water level a minimum of 6 inches below surface of excavation.
- E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- F. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.
  - 1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.
- G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

### 3.3 FIELD QUALITY CONTROL

- A. Observation Wells: Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated; additional observation wells may be required by authorities having jurisdiction.
  - 1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
  - 2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
  - 3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.
- B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION 312319

## SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Sections:
  - 1. Division 01 Section "Construction Progress Documentation" for recording preexisting conditions and excavation support and protection system progress.
  - 2. Division 01 Section "Temporary Facilities and Controls" for temporary utilities and support facilities.
  - 3. Division 31 Section "Dewatering" for dewatering system for excavations.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
  - 1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
  - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
  - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
  - 4. Monitor vibrations, settlements, and movements.

## 1.4 SUBMITTALS

- A. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Coordinate first paragraph below with qualification requirements in Division 01 Section "Quality Requirements."Qualification Data: For qualified professional engineer.
- C. Other Informational Submittals:
  - 1. Photographs: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems. Submit before Work begins.

2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.
  - a. Note locations and capping depth of wells and well points.

#### 1.5 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site.
  1. Review methods and procedures related to excavation support and protection system including, but not limited to, the following:
    - a. Geotechnical report.
    - b. Existing utilities and subsurface conditions.
    - c. Proposed excavations.
    - d. Proposed equipment.
    - e. Monitoring of excavation support and protection system.
    - f. Working area location and stability.
    - g. Coordination with waterproofing.
    - h. Abandonment or removal of excavation support and protection system.

#### 1.6 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
  1. Notify Architect no fewer than two days in advance of proposed interruption of utility.
  2. Do not proceed with interruption of utility without Architect's written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.
  1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
  2. The geotechnical report is included elsewhere in the Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
  1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
  - 1. Corners: Site-fabricated mechanical interlock or Roll-formed corner shape with continuous interlock.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.
- E. Shotcrete: Comply with Division 03 Section "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.
- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- H. Tiebacks: Steel bars, ASTM A 722/A 722M.
- I. Tiebacks: Steel strand, ASTM A 416/A 416M.

## 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 that could develop during excavation support and protection system operations.
  - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.
- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

### 3.2 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

### 3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

### 3.4 TIEBACKS

- A. Tiebacks: Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
  - 1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.
  - 2. Maintain tiebacks in place until permanent construction is able to withstand lateral soil and hydrostatic pressures.

### 3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
  - 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
  - 2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
  - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

### 3.6 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.



1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlaying construction and abandon remainder.
  2. Fill voids immediately with approved backfill compacted to density specified in Division 31 Section "Earth Moving."
  3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

END OF SECTION 315000

## 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, including, in particular, Section 018113 Sustainable Design Requirements.

## 1.2 SUMMARY

## A. Section Includes:

1. Cold milling of existing hot-mix asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt paving overlay.
5. Pavement-marking paint.

## B. Related Sections:

1. Division 02 Section "Structure Demolition" for demolition, removal, and recycling of existing asphalt pavements, and for geotextiles that are not embedded within courses of asphalt paving.
2. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
3. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.
4. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.
5. Maine Department of Transportation (MDOT) Standard Specification, latest edition.

## 1.3 UNIT PRICES

- A. Work of this Section is affected by Section 012200 Unit Prices Bituminous Pavement.

## 1.4 DEFINITION

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
  1. Submit laboratory test reports of the stockpiled aggregates initially used in the mix and additional test reports for each change of source per MDOT Section 401.
  2. Submit laboratory test reports for asphalt cement used in the initial mix and additional test reports for each change of source per MDOT Section 401.

3. Job-Mix Designs: Certification, by MDOT, of approval of each job mix proposed for the Work per MDOT Section 401.

- B. Qualification Data: For qualified manufacturer.
- C. Material Test Reports: For each paving material.
- D. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- E. Material Certificates: For each paving material, from manufacturer.

#### 1.6 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 Maine Department of Transportation Standard Specifications for asphalt paving work..
  - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.
- D. Preinstallation Conference: Conduct conference at Project Site.
  - 1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
    - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
    - b. Review condition of subgrade and preparatory work.
    - c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
    - d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

#### 1.8 PROJECT CONDITIONS

- A. For weather limitations the State will be considered to be divided into 2 paving zones.

1. Zone 1 – All area north of U.S. Route 2 from Gilead to Bangor and north of Route 9 from Bangor to Calais.
  2. Zone 2 – All area south of Zone 1 including the U.S. Route 2 and Route 9 boundaries.
- B. Hot Mix Asphalt Pavement for use other than traveled way, wearing course may be placed in either zone between the dates of April 15<sup>th</sup> and November 15<sup>th</sup>, provided that the air temperature as determined by an approved thermometer (placed in the shade at the paving location) is 40°F or higher and the area to be paved is not frozen.
- C. Hot Mix Asphalt Pavement to be placed as traveled way, wearing course may be placed in Zone 1 between the dates of May 1<sup>st</sup> and the Saturday following October 1<sup>st</sup> and in Zone 2 between the dates of April 15<sup>th</sup> and the Saturday following October 15<sup>th</sup> provided the air temperature determined as above is 50°F or higher. The traveled way as used herein shall also truck lanes, ramps, approach roads and auxiliary lanes.
- D. Hot bituminous mixtures used for curb, driveways, sidewalks, islands or other incidentals are not subject to season limitations, except that weather conditions shall be satisfactory for proper handling and finishing of the mixture. Unless otherwise specified, bituminous plant mix shall not be placed on a wet surface or a frozen surface. The air temperature shall be 40°F or higher.
- E. When it is in the public interest for service to traffic, the Owner's Representative may authorize construction of Hot Mix Asphalt Pavements at lower atmospheric temperatures than those specified or extend the dates of the paving season.
- F. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials 55 deg F for water-based materials, and not exceeding 95 deg F, or MDOT specifications, whichever is more strict.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. All materials and their use shall conform to the requirements of Division 400 – Hot Mix Asphalt Pavement, and Section 627 – Pavement Markings of the MDOT Standard Specifications, latest edition.

### 2.2 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by Maine Department of Transportation and complying with the following requirements:
1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
  2. Base Course: 19.0 mm HMA
  3. Surface Course: 12.5 mm HMA
  4. Surface Course: 9.5 mm HMA (walks – beside drive and around building)

### 2.3 AUXILIARY MATERIALS

- A. Wheel Stops: Solid, integrally colored, 96 percent recycled HDPE or commingled postconsumer and postindustrial recycled plastic; UV stabilized; 4.5 inches high by 7 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.
1. Dowels: AAP-1 Anchor pins 16" x ½ " coated with corrosion resistant black paint
  2. Adhesive: As recommended by wheel-stop manufacturer for application to asphalt pavement.

## PART 3 - EXECUTION

## 3.1 GENERAL

- A. All phases of the execution shall meet the MDOT Specifications for Hot Mix Asphalt.

## 3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated. See MDOT Specifications, Latest Edition, Section 307.
1. Mill to full depth of plus one inch.
  2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
  3. Control rate of milling to prevent tearing of existing asphalt course.
  4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
  5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
  6. Keep milled pavement surface free of loose material and dust.

## 3.3 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd..
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

## 3.4 REPAIRS

- A. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of [**1/4 inch**] <Insert depth>.
1. Clean cracks and joints in existing hot-mix asphalt pavement.
  2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
  3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

## 3.5 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..
  - 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.

### 3.6 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
  - 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
  - 2. Place hot-mix asphalt surface course in single lift.
  - 3. Spread mix at minimum temperature of 250 deg F.
  - 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
  - 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet 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. 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.

### 3.7 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.
  - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
  - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints to meet MDOT specifications.
  - 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.

### 3.8 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. Compaction procedures shall meet MDOT specifications.

- B. 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.
- C. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- D. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 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 or MDOT specifications whichever is stricter.
  - 2. Surface Course: Plus 1/4 inch, no minus or MDOT specifications whichever is stricter.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course: MDOT specifications.
  - 2. Surface Course: MDOT specifications
  - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

### 3.10 PAVEMENT MARKINGS

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.
- B. Allow paving to age for the number of days specified by MDOT 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.

### 3.11 WHEEL STOPS

- A. Install wheel stops in bed of adhesive as recommended by manufacturer.
- B. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

### 3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall provide a qualified testing agency to perform tests and inspections.

- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to MDOT requirements.
  - 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. or less of installed pavement, with no fewer than 3 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.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

### 3.13 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
  - 1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216



## SECTION 321313 - CONCRETE 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, including, in particular, Section 018113 Sustainable Design Requirements.

## 1.2 SUMMARY

- A. Section Includes: cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Plaza and Walks.
  - 2. Bench and bike rack pads.
  - 3. Utility pads.
- B. Related Sections:
  - 1. Division 1 Section "Sustainable Design Requirements."
  - 2. Division 03 Section Cast-in-Place Concrete and Miscellaneous Cast-in-Place Concrete for general building applications of concrete.
  - 3. Division 31 "Earth Moving" for under slab build up.
  - 4. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

## 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
  - 1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
    - b. Design Mixtures for Credit MR 4.1 and MR 4.2: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements. For each design mixture submitted, include an equivalent concrete mixture that does not contain portland cement replacements, to determine amount of portland cement replaced

2. Credit MR 5.1 / 5.2: Product Data indicating location of material manufacturer for regionally manufactured materials.
  - a. Include statement indicating cost and distance from manufacturer to Project for each regional manufactured material.

C. Shop Drawings: Plaza layout

D. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

E. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

F. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

G. Material Test Reports: For each of the following:

1. Aggregates – may include reclaimed concrete aggregate RCA in mix that is adjusted for this substitution.

H. Field quality-control reports.

## 1.5 QUALITY ASSURANCE

A. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

- D. Concrete Testing Service: Owner shall engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures. Contractor shall schedule testing to meet requirements. Reports shall be sent to designer.
- E. ACI Publications: Comply with ACI 301 unless otherwise indicated.
- F. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to concrete paving, including but not limited to, the following:
    - a. Concrete mixture design and the potential use of RCA and recycled brick and/or glass.
    - b. Plaza joint pattern
    - c. Quality control of concrete materials and concrete paving construction practices.
  - 2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Concrete paving subcontractor.

## 1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

## PART 2 - PRODUCTS

### 2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
  - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

### 2.2 STEEL REINFORCEMENT

- A. Recycled Content: Provide products with an average recycled content of steel with postconsumer recycled content not less than 75 percent and preconsumer recycled content not less than 10 percent.
- B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

### 2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
  - 1. Portland Cement: ASTM C 150, white Portland cement Type I or II
  - 2. Include Supplementary Cementitious Materials as a percentage of cementitious materials of at least 25% but not to exceed 40% by weight:
    - a. Fly Ash: ASTM C 618, Class C or Class F.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source.
  - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

### 2.4 FIBER REINFORCEMENT

- A. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116/C 1116M, Type III.

### 2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.

### 2.6 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1752, cork or self-expanding cork in preformed strips.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

## 2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
  - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
  - 1. Compressive Strength (28 Days): 4500 psi.
  - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
  - 3. Slump Limit: 4 inches, plus or minus 1 inch.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
  - 1. Air Content: 5-1/2 percent plus or minus 1.5 percent for 1-1/2-inch nominal maximum aggregate size.
  - 2. Air Content: 6 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.
  - 3. Air Content: 6 percent plus or minus 1.5 percent for 3/4-inch nominal maximum aggregate size.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
- F. Cementitious Materials: Limit percentage by weight of cementitious materials other than portland cement according to ACI 301 requirements as follows:
  - 1. Fly Ash or Pozzolan: 25 percent.
  - 2. Ground Granulated Blast-Furnace Slag: 50 percent.
  - 3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

## 2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.
  - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
  - 1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
  - 2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
  1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
  2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
  3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Remove loose material from compacted base surface immediately before placing concrete.

#### 3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

#### 3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

- E. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- F. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

### 3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
  - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
  - 2. Do not use asphalt impregnated fiberboard as a joint filler.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
  - 1. Continue steel reinforcement across construction joints, particularly in areas of plaza where potential exists for fire trucks to cross the plaza (i.e. – from north parking to main entrance, and from end of Ocean Avenue entrance to asphalt at east classroom wing entrance), unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
  - 2. Provide tie bars at sides of paving strips where indicated.
  - 3. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting granite curbs, catch basins, manholes, inlets, structures, light pole bases, other fixed objects, and where indicated.
  - 1. Locate expansion joints at intervals of 20 feet unless otherwise indicated.
  - 2. Extend joint fillers full width and depth of joint.
  - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
  - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
  - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
  - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Control Joints: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
    - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
    - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
  3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch] radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

### 3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
  1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
  1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
  2. Do not use frozen materials or materials containing ice or snow.



3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

K. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

### 3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line non-slip texture.

### 3.8 DETECTABLE WARNINGS

A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in **[Division 32 Section "Unit Paving"]** <Insert Division number and Section title>.

1. Tolerance for Opening Size: **[Plus 1/4 inch, no minus]** <Insert requirement>.

B. Stamped Detectable Warnings: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.

1. Before using stamp mats, verify that the vent holes are unobstructed.
2. Apply liquid release agent to the concrete surface and the stamp mat.
3. Stamping: **[While initially finished concrete is plastic]** **[After application and final floating of pigmented mineral dry-shake hardener]**, accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.
4. Trimming: After **[24]** <Insert number> hours, cut off the tips of mortar formed by the vent holes.
5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

### 3.9 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing moisture-retaining-cover curing curing compound or a combination of these as follows:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

### 3.10 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
  - 1. Elevation: 3/4 inch.
  - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
  - 3. Surface: Gap below 10-foot- long, unlevelled straightedge not to exceed 1/2 inch.
  - 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
  - 5. Lateral Alignment and Spacing of Dowels: 1 inch.
  - 6. Vertical Alignment of Dowels: 1/4 inch.
  - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
  - 8. Joint Spacing: 3 inches.
  - 9. Contraction Joint Depth: Plus 1/4 inch, no minus.
  - 10. Joint Width: Plus 1/8 inch, no minus.

### 3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
  6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
    - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

### 3.12 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

## SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

## 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, including in particular, Section 018113 Sustainable Design Requirements.

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Cold-applied joint sealants.
  - 2. Hot-applied joint sealants.
- B. Related Sections:
  - 1. Division 32 Section "Asphalt Paving" for constructing joints between concrete and asphalt pavement.
  - 2. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

## 1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, Samples of materials that will contact or affect joint sealants.
  - 1. Use ASTM C 1087 or manufacturer's standard test method, whichever is more strict, to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  - 2. Submit no fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
  - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
  - 5. Testing will not be required if joint-sealant manufacturers submit joint-preparation data that are based on previous testing, not older than 24 months, of sealant products for compatibility with and adhesion to joint substrates and other materials matching those submitted.

## 1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Pavement-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

D. Qualification Data: For qualified Installer.

E. Product Certificates: For each type of joint sealant and accessory, from manufacturer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for joint sealants.

G. Preconstruction Compatibility and Adhesion Test Reports: From joint-sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility with and adhesion to joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

#### 1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each type of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

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

D. Preinstallation Conference: Conduct conference at Project site.

#### 1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

## 2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Crafcoc Inc., an ERGON company; RoadSaver Silicone.
    - b. Dow Corning Corporation; 888.
    - c. Pecora Corporation; 301 NS.
- B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Crafcoc Inc., an ERGON company; RoadSaver Silicone SL.
    - b. Dow Corning Corporation; 890-SL.
    - c. Pecora Corporation; 300 SL.
- C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Pecora Corporation; Urexpam NR-200.

## 2.3 HOT-APPLIED JOINT SEALANTS

- A. Hot-Applied, Single-Component Joint Sealant for Concrete: ASTM D 3406.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Crafcoc Inc., an ERGON company; Superseal 444/777.
- B. Hot-Applied, Single-Component Joint Sealant for Concrete and Asphalt: ASTM D 6690, Types I, II, and III.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Meadows, W. R., Inc.; Sealtight Hi-Spec or Sealtight 3405, as appropriate in the application.
- b. Right Pointe; D-3405 Hot Applied Sealant.

#### 2.4 JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

#### 2.5 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

#### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.



- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of joint-sealant backings.
  - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
  - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place joint sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
  - 1. Remove excess joint sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

### 3.4 CLEANING

- A. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.5 PROTECTION

- A. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

### 3.6 PAVEMENT-JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Joints within cement concrete pavement.
  - 1. Joint Location:

- a. Expansion/control, construction, and isolation joints in cast-in-place concrete pavement.
  - b. Contraction joints in cast-in-place concrete slabs.
  - c. Other joints as indicated.
2. Silicone Joint Sealant for Concrete: Single component, self-leveling.
  3. Urethane Joint Sealant for Concrete: Multicomponent, pourable, traffic-grade.
  4. Hot-Applied Joint Sealant for Concrete: Single component.
  5. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
- B. Joint-Sealant Application: Joints between cement concrete and asphalt pavement.
1. Joint Location:
    - a. Joints between concrete and asphalt pavement.
    - b. Joints between granite curbs and concrete pavement.
    - c. Concrete plaza and concrete bike rack pad
    - d. Other joints as indicated.
  2. Hot-Applied Joint Sealant for Concrete and Asphalt: Single component.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 321373

## SECTION 323113 - CHAIN LINK FENCES AND GATES

## 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, including in particular, Section 018113 Sustainable Design Requirements.

## 1.2 SUMMARY

## A. Section Includes:

1. Six foot Chain-link fence for dumpster enclosure.
2. Gate: for dumpster enclosure.
3. Pole gate: Emergency Access Drive

## B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete " for cast-in-place concrete post footings.

## 1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Chain-link fence and gate framework shall meet requirements of details on Project drawings.
- B. Lightning Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.
  1. Fence and gateposts, rails, and fittings.
  2. Chain-link fabric, reinforcements, and attachments.
  3. Gates and hardware.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.
- C. Qualification Data: For qualified factory-authorized service representative.
- D. Product Certificates: For each type of chain-link fence, and gate, from manufacturer.
- E. Product Test Reports: For framing strength according to ASTM F 1043.

- F. Operation and Maintenance Data: For the following to include in emergency, operation, and maintenance manuals:
  - 1. Polymer finishes.
  - 2. Gate hardware.
- G. Warranty: Sample of special warranty.

## 1.5 QUALITY ASSURANCE

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: Ten years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:
  - 1. Fabric Height: As indicated on Drawings.
  - 2. Steel Wire Fabric: Wire with a diameter of No. 9 gauge.
    - a. Mesh Size: 2 inches.
    - b. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.

### 2.2 FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 or ASTM F 1083 based on the following:
  - 1. Fence Height: 72 inches.
  - 2. Light Industrial Strength:

- a. Line Post: 1.5" diameter galvanized steel pipe.
  - b. End, Corner and Pull Post: 2" diameter galvanized steel pipe.
3. Horizontal Framework Members: Intermediate top and bottom rails complying with ASTM F 1043.
- a. Top Rail: 1.25" diameter.
4. Brace Rails: Comply with ASTM F 1043.
5. Metallic Coating for Steel Framing:
- a. Type A, consisting of not less than minimum 2.0-oz./sq. ft. average zinc coating per ASTM A 123/A 123M or 4.0-oz./sq. ft. zinc coating per ASTM A 653/A 653M.
  - b. Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.
  - c. External, Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil- thick, zinc-pigmented coating.
  - d. Type C, Zn-5-Al-MM alloy, consisting of not less than 1.8-oz./sq. ft. coating.
  - e. Coatings: Any coating above.

### 2.3 SWING GATES

- A. General: Comply with ASTM F 900 for gate posts and single swing gate types
  - 1. Gate Leaf Width: As indicated on drawings.
  - 2. Gate Fabric Height: 72 inches or less.
- B. Pipe and Tubing:
  - 1. Gate Posts: Round tubular steel.
  - 2. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: assembled with corner fittings.
- D. Hardware:
  - 1. Hinges: 270-degree outward(dumpster), 180-degree inward and outward(fire lane gate) swing.
  - 2. Latches permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
  - 3. Padlock and Chain: Owner furnished.
  - 4. Closer: Manufacturer's standard.

### 2.4 FITTINGS

- A. General: Comply with ASTM F 626.

### 2.5 PRIVACY SLATS

- A. Material: Aluminum, not less than 0.01 inch thick, sized to fit mesh specified for direction indicated.
- B. Color: As selected by Architect from manufacturer's full range.

## 2.6 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

## 2.7 FENCE GROUNDING

- A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
  - 1. Material above Finished Grade: Copper.
  - 2. Material on or below Finished Grade: Copper.
  - 3. Bonding Jumpers: Braided copper tape, 1 inch wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- B. Connectors and Grounding Rods: Comply with UL 467.
  - 1. Connectors for Below-Grade Use: Exothermic welded type.
  - 2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
  - 1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, underground structures, benchmarks, and property monuments.

### 3.3 INSTALLATION, GENERAL

- A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated.
  - 1. Install fencing on established boundary lines inside property line.

## 3.4 CHAIN-LINK FENCE INSTALLATION

- A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
  - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
  - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
    - a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.
    - b. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
- C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 30 degrees or more or as indicated on Drawings.
- D. Line Posts: Space line posts uniformly at 7 feet o.c. or to meet manufacturer's requirements, whichever is stricter.
- E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
  - 1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- F. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- G. Intermediate and Bottom Rails: Install and secure to posts with fittings.
- H. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.
- J. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
  - 1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.
- K. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

- L. Privacy Slats: Install slats in direction indicated, securely locked in place.

- 1. Horizontally, for privacy factor of 70 to 75.

### 3.5 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

### 3.6 GROUNDING AND BONDING

- A. Fence Grounding:

- 1. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of a lesser distance if grounding resistance is high.

- a. Gates and Other Fence Openings: Ground fence on each side of opening.

- 1) Bond metal gates to gateposts.
      - 2) Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.

- B. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location, including the following:

- 1. Make grounding connections to each barbed wire strand with wire-to-wire connectors designed for this purpose.
  - 2. Make grounding connections to each barbed tape coil with connectors designed for this purpose.

- C. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

- D. Connections: Make connections to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

- 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

- E. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor complying with NFPA 780.



### 3.7 FIELD QUALITY CONTROL

- A. Grounding-Resistance Testing: Owner will engage a qualified testing agency to perform tests and inspections.
  - 1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance no fewer than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
  - 2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
  - 3. Report: Prepare test reports certified by a testing agency of grounding resistance at each test location. Include observations of weather and other phenomena that may affect test results.

### 3.8 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

### 3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 323113

## SECTION 329200 - TURF AND GRASSES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Soil preparation
  - 2. Seeding.
  - 3. Hydro-seeding.
  - 4. Sodding.
- B. Related Sections include the following:
  - 1. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
  - 2. Division 31 Section "Erosion Control" for erosion and sedimentation control measures.
  - 3. Division 31 Section "Site Clearing" for clearing and grubbing.
- C. References Included in this Section:
  - 1. USDA – United States Department of Agriculture.
  - 2. TPI – Turfgrass Producers International.
  - 3. ASTM- American Society for Testing & Materials.
  - 4. AOSA – Association of Official Seed Analysis.

## 1.3 DEFINITIONS

- A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Topsoil: The uppermost layer of soil characterized by high concentrations of organic matter.
- E. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill that will meet the specified compaction requirements.
- F. Sod: Locally grown turf grass sod of species indicated and capable of vigorous growth and development when planted.
- G. Subgrade: Surface or elevation of subsoil remaining after excavation is completed or top surface of a fill or backfill before planting soil is placed.

- H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

#### 1.4 SUBMITTALS

- A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
  - 1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.
  - 2. For topsoil, submit topsoil analysis done by a plant and soil testing agency such as the Maine Soil Testing and Analytical Lab (207-581-2934) for review by the Owner's Representative. State recommended quantities for amendments necessary to produce satisfactory topsoil as stated in the specifications herein.
  - 3. Submit product information with mix ratios and amounts for hydro mulching to be used during hydro seeding for Owner's Representative's approval.
  - 4. Submit fertilizer, herbicide and fungicide products for application as required for Owner's Representative's approval.
- B. Product Certificates: For soil, soil amendments and fertilizers, from manufacturer.

#### 1.5 QUALITY ASSURANCE

- A. Soil-Testing Laboratory Qualifications: An independent laboratory with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- B. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; soil texture classification, cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.
  - 1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
  - 2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Owner's Representative. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
  - 3. Report suitability of tested soil for turf growth.
    - a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients lime and organic matter to be added to produce satisfactory soil suitable for healthy, viable plants and grasses.
    - b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying. Store in a cool, dry, shaded area.
- C. Bulk Materials:
  - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  - 3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.
- D. Use all means necessary to protect seed from moisture and other contaminants which may adversely effect proper germination.
- E. Use all means necessary to protect fertilizers, amendments and other materials from moisture and other contaminants which may adversely effect their efficacy.

## 1.7 PROJECT CONDITIONS

- A. Seeding Restrictions: Seed during one of the following periods. Coordinate seeding periods with initial maintenance periods to provide required maintenance from date of seeding completion.
  - 1. Spring Planting: April 15 to June 15.
  - 2. Fall Planting: August 15 to October 1.
  - 3. The Contractor may seed at times other than those specified, only upon authorization of the Owner's Representative.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

## 1.8 MAINTENANCE SERVICE

- A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:
  - 1. Seeded Turf: 60 days from date of planting completion.
    - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
  - 2. Sodded Turf: 30 days from date of planting completion.

## PART 2 - PRODUCTS

## 2.1 TOPSOIL

## A. Topsoil:

1. Natural, fertile loam typical of cultivated topsoil of the locality, containing not less than 3.5 percent or more than 8 percent by weight, of decayed organic matter (humus) as determined by ASTM F1647.
2. Obtain from a well drained arable site, free of subsoil, earth clods, large stones, sticks, stumps, clay lumps, roots, or other objectionable, extraneous matter or debris. Screen topsoil to a maximum stone size of 3/4 inch.
3. Provide topsoil that is free of Quack-grass rhizomes, *Agropyron Repens*, and the nut-like tubers of Nutgrass, *Cyperus Esculentus*, and all other primary noxious weeds.
4. Provide topsoil with a pH of not less than 6.0 or greater than 6.8.
5. Provide topsoil with a loam texture classification and do not deliver or use while in a frozen or muddy condition.
6. Provide topsoil that conforms to the following particle size distribution, as determined by pipette method in compliance with ASTM F1632.
  - a. Sand: 40-60 percent.
  - b. Silt: 30-40 percent.
  - c. Clay: 5-20 percent.

## B. Existing topsoil stockpiled from on-site stripping may be utilized if in compliance with the requirements for topsoil. Clean existing soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth. If determined by a soil test the existing topsoil that was stripped does not meet said requirements, the topsoil may be amended to provide an acceptable topsoil for use or replaced by an imported topsoil which conforms to the topsoil specification.

1. Supplement existing topsoil with suitable topsoil when quantities are insufficient.
2. If determined by a soil test the existing topsoil does not meet these specifications, the topsoil may be amended at the Contractor's expense to provide an acceptable topsoil. Once amendments are made the soil shall be retested for compliance with topsoil specifications.

## 2.2 SEED

## A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

## B. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. Lawn Mixture: See L-1 Landscape Plan

## 2.3 TURFGRASS SOD

## A. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. Proportioned by weight as follows:
  - a. 80 percent Kentucky Bluegrass (2 varieties minimum).

- b. 20 percent Perennial Ryegrass (2 varieties minimum).

## 2.4 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
  - 1. Class: O, with a minimum of 98 percent passing through No. 20 sieve and a minimum of 55 percent passing through No. 60 sieve.
  - 2. Provide lime in form of ground dolomitic limestone and as recommended by the soil testing lab.

## 2.5 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 6.1 to 7.8; moisture content 40 to 60 percent by weight; 100 percent passing through 1/2-inch sieve; soluble salt content of less than 2mnh/cm in final topsoil mix; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
  - 1. Organic Matter Content: 30 to 60 percent of dry weight.
  - 2. Nutrients: Provide NPK level information.
  - 3. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8 and an ash content not exceeding 15 percent as determined by ASTM D2974.

## 2.6 FERTILIZERS

- A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
  - 1. As recommended by the soil analysis.
  - 2. Registration: Fertilizer must be registered with the Maine State Department of Agriculture and shall meet their standard requirements.

## 2.7 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley. No material shall be used which is too wet, decayed or compacted as to inhibit even uniform spreading.
- B. Fiber Mulch: Biodegradable, green dyed wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5. Provide in moisture resistant sealed bags marked with the manufacturer's name, the air dry weight and composition of the contents.
- C. Hydro mulch: Shall be Terra-Sorb GB, or an approved equal. Add Terra-Sorb to the hydro seed tank at the amount of 60 pounds per acre.
- D. Mulch Binder: Asphalt emulsion; ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

## 2.8 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
  - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
  - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  - 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

### 3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
  - 1. Protect adjacent and adjoining areas from hydro-seeding and hydro-mulching overspray.
  - 2. Protect grade stakes set by others until directed to remove them.

### 3.3 TURF AREA PREPARATION

- A. Limit turf subgrade preparation to areas to be planted.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared sub-grades, and from flooding project site and surrounding area.
- C. Protect sub-grade 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.
- D. 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. Stockpile soil materials away from edges of excavation and outside drip line of remaining trees.

- E. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- F. It is critical that neither the sub-soil nor top-soil shall be over-compacted and that as soil is brought in to raise the grade that underlying areas be scarified to eliminate layering of materials. Heavy road building equipment should be avoided. Use wide tracked or tired equipment specifically designed to minimize compaction. Heavy equipment should be kept off subgrades and topsoil areas during wet conditions. Should subsoil become compacted the contractor shall rip the soil to a depth of 12 inches and harrow to break up clods prior to proceeding with topsoil spreading operations.
- G. Place soil as indicated on the Drawings in layers not to exceed 8 inches or as directed by the Owner's Representative. Soils shall not be compacted beyond 85%.
  - 1. Spread topsoil to a minimum depth of 6 inches unless otherwise indicated on the plans, apply soil amendments, lime and fertilizer, blend with soil as recommended by the testing lab. Do not spread if subgrade is frozen, muddy, or excessively wet.
    - a. Lime amendment shall be incorporated into the top 4-6 inches of topsoil.
    - b. Fertilizer amendment shall be incorporated into the top 1 inch of topsoil with a follow up surface application in 5 weeks. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
- H. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
  - 1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
  - 2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
  - 3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
  - 4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
- I. Finish Grading: Grade turf areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- J. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- K. Before planting, obtain Owner's Representative acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- L. Provide fertilizer and lime application if recommended by the soil testing lab. Apply with broadcast spreader and incorporate into the top 4 inches of topsoil.

### 3.4 SEEDING

- A. Method of seeding may be varied at discretion of Contractor. It is his or her responsibility to establish a smooth, uniform turf composed of approved grasses.



- B. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
  - 1. Do not use wet seed or seed that is moldy or otherwise damaged.
  - 2. Do not seed against existing trees. Limit extent of seed to outside edge of newly planted tree and shrub pits and beds.
- C. Sow seed at rates indicated on the plans.
- D. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- E. Protect seeded areas with slopes exceeding 1:3 with erosion-control blankets.
- F. Mulch seeded areas with straw mulch, 1-1/2 to 2 tons per acre. Secure mulch at Contractor's discretion as to method or need.

### 3.5 HYDRO-SEEDING

- A. Method of seeding may be varied at discretion of Contractor. It is his or her responsibility to establish a smooth, uniform turf composed of approved grasses.
- B. Hydro-seeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydro-seed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
  - 1. Mix slurry with asphalt-emulsion tackifier.
  - 2. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1400 lb/acre.

### 3.6 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
  - 1. Lay sod across angle of slopes exceeding 1:3.
  - 2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

### 3.7 TURF MAINTENANCE

- A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required until an acceptable, healthy, viable turf is produced. Roll, regrade, and replant bare or eroded areas and add additional mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
  2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
  3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
  4. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
  5. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain a grass height of 2-1/2 to 3 inches until turf is accepted.

### 3.8 INSPECTION AND ACCEPTANCE

- A. Turf installations shall meet the following criteria as determined by Owner's Representative. The Owner's Representative will inspect lawns upon written request by the Contractor. The request shall be received at least ten (10) days before the anticipated date of inspection.
1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
  2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.
- C. If the grass is in satisfactory condition, the Contractor's care and maintenance responsibilities will end. If the grass stand is unsatisfactory, the Contractor's maintenance responsibility shall continue, including a normal program of mowing, trimming, reseeding, fertilization and repair until an acceptable stand of grass is achieved.

### 3.9 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

- C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 329200

## SECTION 329300 - PLANTINGS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:

1. Herbaceous plants, grass plugs etc.
2. Shrubs
3. Trees
4. Planting soils.
5. Tree stabilization.

- B. Related Sections include the following::

1. Division 31 Section "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
2. Division 31 Section "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
3. Division 32 Section "Turf and Grasses" for turf (lawn), seeding, and erosion-control materials.

- C. References Included in this Section:

1. ANSI – American National Standards Institute.
2. ASTM- American Society for Testing & Materials.
3. ASME – American Society of Mechanical Engineers

## 1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than sizes indicated; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated.
- D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.
- E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from

container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

- F. Finish Grade: Elevation of finished surface of planting soil.
- G. Planting Area: Areas to be planted.
- H. Topsoil: The uppermost layer of soil characterized by high concentrations of organic matter.
- I. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See planting details for additional information,
- J. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- K. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- L. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- M. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- N. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- O. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

#### 1.4 SUBMITTALS

- A. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
  1. Manufacturer's certified analysis of standard products.
  2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- B. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.
- C. Warranty: Sample of special warranty.

#### 1.5 QUALITY ASSURANCE

- A. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
- B. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
  2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- C. Plant Material Observation: Owner's Representative may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
1. Notify Owner's Representative of sources of planting materials seven days in advance of delivery to site.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
- B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.
- C. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- E. Handle planting stock by root ball.
- F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.
- G. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
  2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
  3. Do not remove container-grown stock from containers before time of planting.

4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

#### 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.
- C. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
  1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

#### 1.8 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
    - b. Structural failures including plantings falling or blowing over.
    - c. Faulty performance of tree stabilization, edgings, or tree grates.
    - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  2. Warranty Periods from Date of Acceptance: 12 months.
  3. Include the following remedial actions as a minimum:
    - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
    - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
    - c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
    - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

#### 1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: Until date of Substantial Completion.
- B. Initial Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
1. Maintenance Period: Until date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.
  2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.
- E. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery.

### 2.2 FERTILIZERS

- A. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
1. Size: 10-gram tablets.
  2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.



### 2.3 PLANTING SOILS

- A. Refer to Division 32 Section "Turf and Grasses" for topsoil requirements and Drawings for planting soil mix.

### 2.4 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
  - 1. Type: Aged spruce and pine bark, consisting of the outer bark of the trees with minimum hardwood bark. Bark shall be thoroughly mixed and aged in stock piles a minimum of 6 months, partially decomposed, dark brown in color, and generally free of chunks of wood thicker than 1/4". Aged mulch containing an excess of fine particles will not be acceptable.

### 2.5 TREE STABILIZATION MATERIALS

- A. Stakes and Guys:
  - 1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
    - a. Guying: 30 inches long.
    - b. Staking: 96 inches long.
  - 2. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 14 gage in diameter, with rubber hose or Chain Lock brand plastic tree tie or approved equivalent.
  - 3. Wrapping Material: First quality, heavy, waterproof crepe paper manufactured for this purpose; not less than 4" wide. Install only when required as noted on the drawings.
- B. Root-Ball Stabilization Materials:
  - 1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated; stakes pointed at one end.
  - 2. Wood Screws: ASME B18.6.1.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
  - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
  - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  - 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Owner's Representative and replace with new planting soil.

### 3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Owner's Representative acceptance of layout before excavating or planting. Make minor adjustments as required.
- C. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

### 3.3 PLANTING AREA ESTABLISHMENT

- A. Loosen subgrade of planting areas to a minimum depth of 12 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- C. Before planting, obtain Owner's Representative acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- D. Application of Mycorrhizal Fungi: Apply as required for best plant growth.

### 3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
  - 1. Excavate planting pits as indicated on the drawings or as follows if not indicated:
    - a. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
    - b. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
    - c. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
    - d. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
  - 2. Maintain supervision of excavations during working hours.
  - 3. Keep excavations covered or otherwise protected at all times.
  - 4. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.

- B. Subsoil and topsoil removed from excavations may be used as planting soil if determined suitable for site conditions and plant selections.
- C. Obstructions: Notify Owner's Representative if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
  - 1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Owner's Representative if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow too percolate away before positioning trees and shrubs.

### 3.5 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare as indicated to adjacent finish grades.
  - 1. Use planting soil for backfill.
  - 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
  - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  - 4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
  - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

### 3.6 MECHANIZED TREE SPADE PLANTING

- A. Trees may be planted with an approved mechanized tree spade or as directed by Owner's Representative. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than the manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.
- B. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.
- C. Cut exposed roots cleanly during transplanting operations.

- D. Use the same tree spade to excavate the planting hole as was used to extract and transport the tree.
- E. Where possible, orient the tree in the same direction as in its original location.

### 3.7 TREE, SHRUB, AND VINE PRUNING

- A. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Owner's Representative, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- B. Do not apply pruning paint to wounds.

### 3.8 TREE STABILIZATION

- A. Install trunk stabilization as follows unless otherwise indicated:
  - 1. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation. Set vertical stakes and space to avoid penetrating root balls or root masses.
  - 2. Use two stakes for trees up to 12 feet high; three stakes for trees less than 14 feet high and greater than 2-1/2 inches in caliper. Space stakes equally around trees.
  - 3. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

### 3.9 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on the drawing in even rows with triangular spacing for review by Owner's Representative.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

### 3.10 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.

## 3.11 EDGING INSTALLATION

- A. Shovel-Cut Edging: Separate mulched areas from turf areas, curbs, and paving with a 45-degree, 4- to 6-inch- deep, shovel-cut edge as shown on Drawings.

## 3.12 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

## 3.13 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

## 3.14 INSPECTION AND ACCEPTANCE

- A. The Owner's Representative will inspect all planting in the presence of the contractor at the end of the maintenance period and at the end of the warranty period and make all necessary adjustments, repairs, and replacements.
  - 1. Contractor to repair or replace plantings and accessories that fail in materials, workmanship, or growth as defined under Warranty specified hereinbefore.

## 3.15 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.16 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 329300

## SECTION 334100 - STORM UTILITY DRAINAGE 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, including in particular, Section 018113 Sustainable Design Requirements.
- B. City of Portland "Technical and Design Standards and Guidelines", where applicable.

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Pipe and fittings.
  - 2. Nonpressure transition couplings.
  - 3. Expansion joints and deflection fittings.
  - 4. Drains.
  - 5. Encasement for piping.
  - 6. Manholes.
  - 7. Channel drainage systems.
  - 8. Catch basins.
  - 9. Stormwater inlets.

## 1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  - 1. Manholes: Include plans, elevations, sections, details, frames, and covers.
  - 2. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.
  - 3. Filtration bed – final underdrain layout
- C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- D. Field quality-control reports.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle catch basins and manholes according to manufacturer's written rigging instructions.

## 1.6 PROJECT CONDITIONS

## PART 2 - PRODUCTS

## 2.1 PE PIPE AND FITTINGS

- A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10: AASHTO M 252M, Type S, with smooth waterway for coupling joints.
  - 1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.
  - 2. Soiltight Couplings: AASHTO M 252M, corrugated, matching tube and fittings.
- B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294M, Type S, with smooth waterway for coupling joints.
  - 1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
  - 2. Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

## 2.2 NONPRESSURE TRANSITION COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
  - 1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
  - 2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings:
  - 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. Fernco Inc.
  - 2. Description: Elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Shielded, Flexible Couplings:



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. Fernco, Inc.
2. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

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. Fernco Inc.
2. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

## 2.3 CLEANOUTS

A. Plastic Cleanouts:

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. Canplas LLC.
  - b. IPS Corporation.
  - c. NDS Inc.
  - d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.
2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

## 2.4 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.

9. Steps: 3/8-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step, and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12-inch intervals.
10. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers: Storm manhole No. 1 and 2

1. Description: Meet City of Portland Design Standards for frames and covers. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

## 2.5 CONCRETE

A. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

B. Drainage Specialties: Precast, polymer-concrete units.

1. Large Catch Basins:
  - a. 24-by-12-inch polymer-concrete body, with outlets in quantities and sizes indicated.
  - b. Gray-iron slotted grate.
  - c. Frame: Include gray-iron or steel frame for grate.
2. Small Catch Basins:
  - a. 19- to 24-inch by approximately 6-inch polymer-concrete body, with outlets in quantities and sizes indicated.
  - b. Gray-iron slotted grate.
  - c. Frame: Include gray-iron or steel frame for grate.

C. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.

D. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

## 2.6 PLASTIC, CHANNEL DRAINAGE SYSTEMS

A. General Requirements for Plastic, Channel Drainage Systems:

1. Modular system of plastic channel sections, grates, and appurtenances.
2. Designed so grates fit into frames without rocking or rattling.
3. Number of units required to form total lengths indicated.

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

1. ACO USA.
2. MultiDrain Systems, Inc.
3. NDS Inc.
4. Tuf-Tite Corporation.
5. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.

- C. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
- D. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

## 2.7 CATCH BASINS

### A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate.
8. Steps: 3/8-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step, and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12-inch intervals.
9. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

### B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading.

1. "F" basin - Size: 24 by 24 inches minimum unless otherwise indicated. Include flat grate with small square or short-slotted drainage openings that is bicycle safe and meets City of Portland Standards.
2. CBs 1 and 2 – 24 inch minimum diameter "Beehive" grate and frame, as manufactured by Etheridge Foundry, or approved equal.

## 2.8 STORMWATER OUTLETS

- A. Riprap basins – see drawing C500 for energy dissipater detail.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

### 3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. 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.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of micro tunneling.
- F. Install gravity-flow, nonpressure drainage piping according to the following:
  - 1. Install piping pitched down in direction of flow.
  - 2. Install piping according to specifications of the appropriate utility or the City of Portland Standards.
  - 3. Install ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
  - 4. Install PE corrugated sewer piping according to ASTM D 2321.
  - 5. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
  - 6. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
- G. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:
  - 1. Ductile-iron pipe and fittings.
  - 2. Expansion joints and deflection fittings.

### 3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping according to the following:
  - 1. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
  - 2. Join ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
  - 3. Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.
  - 4. Join corrugated PE piping according to ASTM D 3212 for push-on joints.
  - 5. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
  - 6. Join PVC corrugated sewer piping according to ASTM D 2321 for elastomeric-seal joints.
  - 7. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
  - 8. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
  - 9. Join dissimilar pipe materials with nonpressure-type flexible couplings.

### 3.4 DRAIN INSTALLATION

- A. Install type of drains in locations indicated.
  - 1. Use Light-Duty, top-loading classification drains in grassed or unpaved foot-traffic areas.
  - 2. Use Medium-Duty, top-loading classification drains in paved foot-traffic areas.
  - 3. Use Heavy-Duty, top-loading classification drains in vehicle-traffic service areas.
- B. Embed drains in 4-inch minimum concrete around bottom and sides or meet manufacturers specifications, whichever is stricter.
- C. Fasten grates to drains if indicated.
- D. Set drain frames and covers with tops flush with pavement surface.
- E. Assemble trench sections with flanged joints.
- F. Embed trench sections in [4-inch] minimum concrete around bottom and sides or as specified by manufacturer.

### 3.5 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Install waterproofing as indicated in City of Portland Design Standards.
- D. Install ballast where needed to prevent flotation.
- E. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
- F. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

### 3.6 CATCH BASIN INSTALLATION

- A. Install precast catch basins to sizes and shapes indicated and to meet City of Portland standards.
- B. Install waterproofing as indicated in City of Portland Design Standards.
- C. Install ballast where needed to prevent flotation.
- D. Set frames and grates to elevations indicated.

### 3.7 STORMWATER AND OUTLET INSTALLATION

- A. Construct energy dissipaters at outlets, as indicated.

## 3.8 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

## 3.9 CHANNEL DRAINAGE SYSTEM INSTALLATION

- A. Install with top surfaces of components, except piping, flush with finished surface.
- B. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.
- C. Embed channel sections and drainage specialties in **[4-inch]** minimum concrete around bottom and sides, or as specified by the manufacturer whichever is stricter.
- D. Fasten grates to channel sections if indicated.
- E. Assemble channel sections with flanged or interlocking joints.
- F. Embed channel sections in **[4-inch]** **<Insert dimension>** minimum concrete around bottom and sides.

## 3.10 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."
- B. Make connections to underground manhole.
  - 1. Core drill existing manhole for pipe installation. City of Portland personnel shall be notified and on site when contractor is installing new pipe in the City structures.
  - 2. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
    - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
  - 3. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
  - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure storm piping unless otherwise indicated.
    - a. Flexible couplings for same or minor difference OD pipes.
    - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

### 3.11 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Remove and dispose appropriately of all abandoned pipe. Recycle where possible.
- B. Abandoned Manholes and Structures: Remove and dispose appropriately of all abandoned pipe. Recycle where possible.
- C. Backfill to grade according to Division 31 Section "Earth Moving."

### 3.12 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
  - 1. Use detectable warning tape over ferrous piping.
  - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

### 3.13 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Submit separate reports for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  - 1. Do not enclose, cover, or put into service before inspection and approval.
  - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
  - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
  - 4. Submit separate report for each test.
  - 5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
    - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
    - b. Option: Test plastic piping according to ASTM F 1417.
- C. Leaks and loss in test pressure constitute defects that must be repaired.

- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.14 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 334100



## SECTION 334600 - SUBDRAINAGE

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, including in particular, Section 018113 Sustainable Design Requirements.
- B. City of Portland "Technical and Design Standards and Guidelines", where applicable.

## 1.2 SUMMARY

- A. This Section includes subdrainage systems for the following:
  - 1. Foundations.
  - 2. Underslab areas.
  - 3. Bio-retention beds
- B. Related Sections include the following:
  - 1.

## 1.3 DEFINITIONS

- A. HDPE: High-density polyethylene plastic.
- B. PE: Polyethylene plastic.
- C. PVC: Polyvinyl chloride plastic.
- D. Subdrainage: Drainage system that collects and removes subsurface or seepage water.

## 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Perforated-wall pipe and fittings.
  - 2. Solid-wall pipe and fittings.
  - 3. Drainage conduits.
  - 4. Geotextile filter fabrics.

## PART 2 - PRODUCTS

## 2.1 PIPING MATERIALS

- A. Refer to the "Piping Applications" Article in Part 3 for applications of pipe, tube, fitting, and joining materials.

## 2.2 PERFORATED-WALL PIPES AND FITTINGS

- A. Perforated PE Pipe and Fittings:
  - 1. NPS 6 and Smaller: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.
  - 2. NPS 8 and Larger: ASTM F 667; AASHTO M 252, Type CP; or AASHTO M 294, Type CP; corrugated; for coupled joints.
  - 3. Couplings: Manufacturer's standard, band type.
- B. Perforated PVC Sewer Pipe and Fittings: ASTM D 2729, bell-and-spigot ends, for loose joints.

## 2.3 SOLID-WALL PIPES AND FITTINGS

- A. PE Drainage Tubing and Fittings: AASHTO M 252, Type S, corrugated, with smooth waterway, for coupled joints.
  - 1. Couplings: AASHTO M 252, corrugated, band type, matching tubing and fittings.
- B. PE Pipe and Fittings: AASHTO M 294, Type S, corrugated, with smooth waterway, for coupled joints.
  - 1. Couplings: AASHTO M 294, corrugated, band type, matching tubing and fittings.

## 2.4 SPECIAL PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant metal tension band and tightening mechanism on each end.
  - 1. Sleeve Materials:
    - a. For Concrete Pipes: ASTM C 443, rubber.
    - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
    - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
  - 2. Unshielded Flexible Couplings: Elastomeric sleeve with corrosion-resistant metal tension band and tightening mechanism on each end.
  - 3. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant metal tension band and tightening mechanism on each end.

## 2.5 CLEANOUTS

- A. PVC Cleanouts: ASTM D 3034, PVC cleanout threaded plug and threaded pipe hub.
  - a. D 4716.
  - 2. Nominal Size: 18 inches high by approximately 1-1/4 inches thick.
    - a. Minimum In-Plane Flow: **[45 gpm]** <Insert value> at hydraulic gradient of **[1.0]** <Insert value> when tested according to ASTM D 4716.
  - 3. Filter Fabric: Nonwoven, needle-punched geotextile.
  - 4. Fittings: HDPE with combination NPS 4 and NPS 6 outlet connection.
  - 5. Couplings: HDPE.

## 2.6 SOIL MATERIALS

- A. Backfill, drainage course, impervious fill, and satisfactory soil materials are specified in Division 31 Section "Earth Moving."

## 2.7 GEOTEXTILE FILTER FABRICS

- A. Description: Geotextile filter fabrics are specified in Division 31 Section "Earth Moving".

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.
- B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

### 3.3 PIPING APPLICATIONS

- A. Underground Subdrainage Piping:
  - 1. Perforated PE pipe and fittings, couplings, and coupled joints.
  - 2. Perforated PVC sewer pipe and fittings for loose, bell-and-spigot joints.
- B. Header Piping:
  - 1. PE drainage tubing and fittings, couplings, and coupled joints.
  - 2. PVC sewer pipe and fittings, couplings, and coupled joints.

### 3.4 CLEANOUT APPLICATIONS

- A. In Underground Subdrainage Piping:
  - 1. At Grade in Earth: PVC cleanouts.
  - 2. At Grade in Paved Areas: Cast-iron cleanouts.

### 3.5 FOUNDATION DRAINAGE INSTALLATION

- A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches deep and 12 inches wide.
- B. Place impervious fill on subgrade adjacent to bottom of footing and compact to dimensions indicated, but not less than 6 inches deep and 12 inches wide after concrete footing forms have been removed.
- C. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- D. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.
- E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for foundation subdrainage.
- F. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.
- G. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.
- H. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
- I. Do not use drainage panels as protection for waterproof membrane unless approved by factory-authorized service representative of waterproofing membrane manufacturer. Submit approval if so used.
- J. Place initial backfill material over compacted drainage course . Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

### 3.6 LANDSCAPING DRAINAGE INSTALLATION

- A. Provide trench width to allow installation of drainage conduit. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.
- D. Install drainage conduits as indicated in Part 3 "Piping Installation" Article for landscaping subdrainage with horizontal distance of at least 6 inches between conduit and trench walls. Wrap drainage conduits without integral geotextile filter fabric with flat-style geotextile filter fabric before installation. Connect fabric sections with **[adhesive] [or] [tape]**.

- E. Add drainage course to top of drainage conduits.
- F. After satisfactory testing, cover drainage conduit to within 12 inches of finish grade.
- G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
- H. Fill to Grade: Place satisfactory soil fill material over drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

### 3.7 PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.
  - 1. Foundation Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 4.5 feet, unless otherwise indicated.
  - 2. Bio-retention bed drainage.
  - 3. Lay perforated pipe with perforations down.
  - 4. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.
- B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.
- C. Install PE piping according to ASTM D 2321.
- D. Install PVC piping according to ASTM D 2321.

### 3.8 PIPE JOINT CONSTRUCTION

- A. Join PE pipe, tubing, and fittings with couplings for soil-tight joints according to AASHTO's "Standard Specifications for Highway Bridges," Division II, Section 26.4.2.4, "Joint Properties."
- B. Join perforated, PE pipe and fittings with couplings for soil-tight joints according to AASHTO's "Standard Specifications for Highway Bridges," Division II, Section 26.4.2.4, "Joint Properties"; or according to ASTM D 2321.
- C. Join PVC pipe and fittings according to ASTM D 3034 with elastomeric seal gaskets according to ASTM D 2321.
- D. Join perforated PVC pipe and fittings according to ASTM D 2729, with loose bell-and-spigot joints.
- E. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

### 3.9 CLEANOUT INSTALLATION

- A. Cleanouts for Foundation, and Bio-retention Subdrainage:

1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction or as directed on the drawings. Install fittings so cleanouts open in direction of flow in piping.
2. In nonvehicular-traffic areas, use NPS 4 PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches in depth. Set top of cleanout plug 1 inch above grade.

### 3.10 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect low elevations of subdrainage system to solid-wall-piping storm drainage system.

### 3.11 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping.
  1. Install detectable warning tape over nonferrous piping and over edges of underground structures.

### 3.12 FIELD QUALITY CONTROL

- A. Testing: After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

### 3.13 CLEANING

- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600

## SECTION 334713 - POND AND RESERVOIR LINERS

## 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 geomembrane liners for bio-retention bed with lowest elevation in groundwater.
- B. Related Sections:
  - 1. Division 03 Section "Cast-in-Place Concrete" for perimeter concrete.
  - 2. Division 31 Section "Earth Moving" for excavating, compacting, and grading the subgrade; for excavating and backfilling the anchor trench; for protecting the earthwork; for adding requirements for the earth cover; and for the filter fabric and other geotextiles.
  - 3. Division 31 Section "Dewatering" for removing ground water from subgrade to the extent required by liner manufacturer.
  - 4. Division 33 Section "Subdrainage" for drain piping for floating covers.

## 1.3 DEFINITIONS

- A. Plastics Terminology: See ASTM D 1600 for definitions of abbreviated terms for plastics not otherwise defined in this Section.
- B. EPDM: Ethylene-propylene-diene terpolymer.
- C. LLDPE: Linear Low Density Polyethylene
- D. PP: Polypropylene.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Provide geomembrane liners that prevent the passage of groundwater to filtration soils and underdrain

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
  - 1. Sheets for geomembrane liners.
  - 2. Seaming adhesives, solvents, and extrusions.
  - 3. Penetration assemblies.

- B. Shop Drawings: Show fabrication and installation details for geomembrane liners. Show panel layout, seams, penetrations, perimeter anchorage, and methods of attachment and sealing to other construction. Differentiate between factory and field seams and joints.
- C. Samples: For the following products, in sizes indicated:
  - 1. Geomembrane Panels: For each type, not less than one 12-inch seam length for factory-bonded sheets and one 12-inch seam length for field-bonded sheets.
- D. Qualification Data: For qualified Installer.
- E. Product Certificates: For each type of geomembrane liner, from manufacturer.
- F. Product Test Reports: For each geomembrane sheet, based on evaluation of comprehensive tests performed by a qualified testing agency.
- G. Source quality-control reports.
- H. Field quality-control reports.
- I. Maintenance Data: For geomembrane liner to include in maintenance manuals.
- J. Warranty: Special warranty specified in this Section.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain geomembrane liner, accessories, and required seaming materials, solvents, and adhesives from single source.
- C. Preinstallation Conference: Conduct conference at Project site.
  - 1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
  - 2. Review structural load limitations.
  - 3. Review limitations on equipment and Installer's personnel.
  - 4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 5. Review required testing, inspecting, and certifying procedures.
  - 6. Review existing and forecasted weather conditions and procedures for unfavorable conditions.

#### 1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit placement and seaming of geomembrane liners and floating covers to be performed according to manufacturers' written instructions and warranty requirements.

#### 1.8 WARRANTY

- A. Special Warranty: Specified form in which geomembrane manufacturer, geomembrane liner and floating cover fabricator, and geomembrane liner Installer agree to repair or replace geomembrane liner that fail(s) in materials or workmanship or that deteriorate(s) under conditions of normal weather within specified



warranty period. Warranty does not include deterioration or failure of geomembrane liner due to exposure to harmful chemicals, gases or vapors, abnormal and severe weather phenomena, fire, earthquakes, floods, vandalism, or abuse by persons, animals, or equipment.

1. Failures include, but are not limited to, the following:
  - a. Leaks in geomembrane liner.
  - b. Defects in seams.
  - c. Cracks and holes in floating cover.
2. Warranty Period: Three year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 EPDM SHEET MATERIALS

- A. EPDM Sheet: Formulated from EPDM, compounded for use in hydraulic structures and formed into uniform, flexible sheets.
  1. Nominal Thickness: 45-mil-thick sheet per ASTM D 5199 or ASTM D 751, Optical Method.
  2. Breaking Strength: Not less than 190 lbf minimum average per ASTM D 882, ASTM D 7004, or ASTM D 751, Procedure A.
  3. Tear Resistance: Not less than 130 lb minimum average per ASTM D 1004.
  4. Puncture Strength: Not less than 60 lbf minimum average per ASTM D 4833.
  5. D 1693, Condition B.

### 2.2 LLDPE SHEET MATERIALS

- A. LLDPE Sheet: formed into uniform, flexible sheets.
  1. Sheet Texture: One side smooth; other side textured.
  2. Nominal Thickness: 30 mil-thick sheet per ASTM D 5994.
  3. Tensile Strength: Not less than 250 lbf minimum average per ASTM D 412, ASTM D 7003, ASTM D 6693, or ASTM D 751, Procedure A.
  4. Tear Resistance: Not less than 22lbf minimum average per ASTM D 1004, ASTM D 5884, ASTM D 7003, or ASTM D 751, Procedure B.
  5. Puncture Resistance: Not less than 44lbf minimum average per ASTM D 4833 or ASTM D 7003.
  6. A minimum 8-ounce non-woven fabric reinforcement underlayment and 12-ounce overlayment shall be installed.

### 2.3 PP SHEET MATERIALS

- A. PP Sheet: Formulated from virgin PP, compounded for use in hydraulic structures, and formed into uniform, flexible sheets.
  1. Sheet Texture: One side smooth; other side textured.
  2. Nominal Thickness: 36 mil-thick sheet per ASTM D 5994.
  3. Tensile Strength: Not less than 250 lbf minimum average per ASTM D 412, ASTM D 7003, ASTM D 6693, or ASTM D 751, Procedure A.
  4. Tear Resistance: Not less than 22lbf minimum average per ASTM D 1004, ASTM D 5884, ASTM D 7003, or ASTM D 751, Procedure B.

5. Puncture Resistance: Not less than 44lbf minimum average per ASTM D 4833 or ASTM D 7003.
6. A minimum 8-ounce non-woven fabric reinforcement underlayment and 12-ounce overlayment shall be installed.

#### 2.4 FABRICATION

- A. Fabricate geomembrane liner panels from sheets in sizes as large as possible with factory-sealed seams, consistent with limitations of weight and installation procedures. Minimize field seaming.

#### 2.5 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to evaluate geomembrane seams.
- B. Destructive Testing: Test for bonded seam strength and peel adhesion every 3000 feet or once per panel, whichever is more frequent.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for soil compaction and grading; for subgrade free from angular rocks, rubble, roots, vegetation, debris, voids, protrusions, and ground water; and for other conditions affecting performance of geomembrane liner.
- B. Examine anchor trench excavation, where geomembrane liner will be secured, for substrate conditions indicated above and for correct location and configuration.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Provide temporary ballast, until edges are permanently secured, that does not damage geomembrane liner or substrate, to prevent uplift of geomembrane liner in areas with prevailing winds.
- B. Prepare surfaces of construction penetrating through geomembrane liner according to geomembrane liner manufacturer's written instructions.

#### 3.3 INSTALLATION

- A. General: Place geomembrane liner over prepared surfaces to ensure minimum handling. Install according to Shop Drawings and in compliance with geomembrane liner manufacturer's written instructions. Begin placing geomembrane liner at Project's upwind direction and proceed downwind. Install geomembrane liner in a relaxed condition, free from stress and with minimum wrinkles, and in full contact with subgrade. Do not bridge over voids or low areas in the subgrade. Fit closely and seal around inlets, outlets, and other projections through geomembrane liner. Permanently secure edges.
- B. Field Seams: Comply with geomembrane liner manufacturer's written instructions. Form seams by lapping edges of panels 2 to 4 inches unless instructions require a larger overlap. Wipe contact surfaces clean and free of dirt, dust, moisture, and other foreign materials. Use solvent-cleaning methods and

grind geomembrane seam surfaces if recommended by geomembrane liner manufacturer. Proceed with seaming at required temperatures for materials and ambient conditions. Continuously bond sheet to sheet to construct single or double seams of width recommended for method of seaming used. Seal or fuse free seam edges. Inspect seams and reseal voids.

1. Adhesive Bonding: Apply bonding cement to both contact surfaces in seam area and press together immediately, or use other seaming methods as instructed by geomembrane liner manufacturer. Roll to press surfaces together, to distribute adhesive to leading edges of panels, and to remove wrinkles and fishmouths. Remove excess adhesive.
  2. Thermal Bonding: Use thermal-welding technique recommended by geomembrane liner manufacturer. Apply pressure to smoothly bond surfaces together. Examine for and patch wrinkles and fishmouths.
- C. Installation in Anchor Trench: Install geomembrane liner in trench according to manufacturer's written instructions. Backfill and compact to lock liner into trench.
- D. Liner Repairs: Repair tears, punctures, and other imperfections in geomembrane liner field and seams using patches of geomembrane liner material, liner-to-liner bonding materials, and bonding methods according to geomembrane liner manufacturer's written instructions. Apply bonding solvent or weld to contact surfaces of both patch and geomembrane liner, and press together immediately. Roll to remove wrinkles.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Nondestructive Testing: Visually inspect seams and patches. Comply with ASTM D 4437 for Air Lance Test, Vacuum Box Testing, or Ultrasonic (High Frequency) Pulse Echo Testing or with GRI Test Method GM6, as applicable to geomembrane liner and seam construction. Record locations of failed seams and patches. Individually number and date occurrences and details of leak and remedial action. Repair leaking seams and patches.
- C. Prepare test and inspection reports.

### 3.5 PROTECTION

- A. Protect installed geomembrane liner according to manufacturer's written instructions. Repair or replace areas of geomembrane liner damaged by scuffing, punctures, traffic, rough subgrade, or other unacceptable conditions.
- B. Before initial placement of earth cover, inspect seams and patched areas to ensure tight, continuously bonded installation. Repair damaged geomembrane and seams and reinspect repaired work.

END OF SECTION 334713



STATE OF MAINE  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
17 STATE HOUSE STATION  
AUGUSTA, ME 04333

DEPARTMENT ORDER  
IN THE MATTER OF

CITY OF PORTLAND AND PORTLAND ) STORMWATER MANAGEMENT LAW  
PUBLIC SCHOOLS )  
Portland, Cumberland County )  
NEW ELEMENTARY SCHOOL )  
L-24314-NJ-B-N (Approval) ) FINDINGS OF FACT AND ORDER

Pursuant to the provisions of 38 M.R.S.A. Section 420-D, and Chapters 500 and 502 of the Department's Regulations, the Department of Environmental Protection has considered the application of the CITY OF PORTLAND AND PORTLAND PUBLIC SCHOOLS with the supportive data, agency review comments, and other related materials on file and FINDS THE FOLLOWING FACTS:

1. PROJECT DESCRIPTION:

A. History: The existing Baxter School was constructed in approximately 1955 on an approximately 12-acre parcel of land. In a letter dated August 8, 2008, the Department approved the City of Portland's authority to review the proposed redevelopment of the Baxter School site for a new elementary school. The proposed project includes the demolition of the existing building and construction of a new school with associated improvements.

B. Summary: The applicants propose to construct a stormwater management system for a new elementary school with three acres of impervious area and 6.7 acres of disturbed area. The project is shown on set of plans, the first of which is entitled "Ocean Avenue Elementary School," prepared by WBRC Architects and Engineers, and dated July 29, 2008, with a latest revision date on any of the sheets of November 3, 2008. The project site is located on the west side of Ocean Avenue in the City of Portland.

The applicants submitted a Natural Resources Protection Act (N.R.P.A.) Permit-by-Rule notification form (PBR #46403) for activities within 75 feet of a stream to accommodate a playing field, a corner of the proposed school building, and two stormwater outfalls. The layout of the proposed project will result in a minimum of 45 feet undisturbed area from the edge of the wetland associated with the stream.

C. Current Use of the Site: The site of the proposed project currently contains the Baxter School, which houses the School Department's multilingual and adult education programs. The school development covers approximately 3.5 acres of the project site. Approximately 1.6 acres of the developed area is currently impervious.

## 2. STORMWATER STANDARDS:

The proposed project includes approximately three acres of impervious area and 6.7 acres of developed area. The project site discharges into the City of Portland's storm sewer system, which flows into Back Cove, a tidal waterbody. The applicants submitted a stormwater management plan based on the basic, general, and flooding standards contained in Department Rules, Chapter 500. The proposed stormwater management system consists of six bio-retention basins that discharge into an existing subsurface storm drain system.

### A. Basic Standards:

(1) Erosion and Sedimentation Control: The applicants submitted an Erosion and Sedimentation Control Plan that is based on the performance standards contained in Appendix A of Chapter 500 and the Best Management Practices outlined in the Maine Erosion and Sediment Control BMPs, which were developed by the Department. This plan and plan sheets containing erosion control details were reviewed by, and revised in response to the comments of the Division of Watershed Management (DWM) of the Bureau of Land and Water Quality (BLWQ).

Erosion control details will be included on the final construction plans and the erosion control narrative will be included in the project specifications to be provided to the construction contractor.

(2) Inspection and Maintenance: The applicants submitted a maintenance plan that addresses both short and long-term maintenance requirements. This plan was reviewed by, and revised in response to the comments of DWM. The maintenance plan is based on the standards contained in Appendix B of Chapter 500. The applicants will be responsible for the maintenance of the stormwater management system.

(3) Housekeeping: The proposed project will comply with the performance standards outlined in Appendix C of Chapter 500.

Based on DWM's review of the erosion and sedimentation control plan and the maintenance plan, the Department finds that the proposed project meets the Basic Standards contained in Chapter 500(4)(A).

B. General Standard: The applicants' stormwater management plan includes general treatment measures that will mitigate for the increased frequency and duration of channel erosive flows due to runoff from smaller storms, provide for effective treatment of pollutants in stormwater, and mitigate potential temperature impacts. This mitigation is being achieved by using Best Management Practices that will control runoff from no less than 95% of the impervious area and no less than 80% of the developed area. These numbers do not include the Ocean Avenue entrance and a portion of the Walton Street entrance that have been in existence since 1955.

The stormwater management system proposed by the applicants was reviewed by, and revised in response to, comments from DWM. After a final review, DWM commented that the proposed stormwater management system is designed in accordance with the Chapter 500 General Standard. DWM recommended that the applicants be required to

retain their design engineer, or other qualified professional, to inspect the installation of the bio-retention basins, and upon completion, submit a letter to the BLWQ certifying that the structures were installed in accordance with the approved plans. Inspections must consist of weekly visits to the site by the engineer to inspect the subgrade preparation at each bio-retention basin locations on the site, embankment construction, pipe bedding placement, underdrain pipe installation, soil filter placement, and overflow installation from initial ground disturbance to final stabilization.

The applicants submitted a letter from the City of Portland, dated October 31, 2008, which states that the existing municipal storm sewer system is capable of handling stormwater runoff from the proposed project.

#### C. Flooding Standard:

The applicants are not proposing a formal stormwater management system to detain stormwater from 24-hour storms of 2-, 10-, and 25-year frequency. Instead, since the project site discharges to the Atlantic Ocean through the municipal storm sewer system, the applicants requested a waiver from the flooding standard pursuant to Department Rules, Chapter 500(4)(E)(2)(a).

DWM commented that the proposed system is designed in accordance with the Chapter 500 Flooding Standard.

Based on the system's design and DWM's review, the Department finds that the applicants have made adequate provision to ensure that the proposed project will meet the Chapter 500, Flooding Standard for peak flow from the project site, and channel limits and runoff areas.

Based on the stormwater system's design and DWM's review, the Department finds that the applicants have made adequate provision to ensure that the proposed project will meet the Chapter 500, Basic and General Standards. The Department further finds that the proposed project will meet the Chapter 500 standards for management of stormwater discharges and discharges to public storm sewer systems.

BASED on the above findings of fact, and subject to the conditions listed below, the Department makes the following conclusions pursuant to 38 M.R.S.A. Section 420-D, and Chapters 500 and 502 of the Department's Regulations:

- A. The applicants have made adequate provision to ensure that the proposed project will meet the Chapter 500 Basic Standards for: (1) erosion and sediment control; (2) inspection and maintenance; (3) housekeeping; and (4) grading and construction activity.
- B. The applicants have made adequate provision to ensure that the proposed project will meet the Chapter 500 General Standard provided a certification on the installation of the stormwater management system is submitted as described in Finding 2B.
- C. The applicants have made adequate provision to ensure that the proposed project will meet the Chapter 500 standards for management of stormwater discharges and discharges to public storm sewer systems.

THEREFORE, the Department APPROVES the above noted application of the CITY OF PORTLAND AND PORTLAND PUBLIC SCHOOLS to construct a stormwater management system to serve a new elementary school as described above in Portland, Maine, SUBJECT TO THE FOLLOWING CONDITIONS, and all applicable standards and regulations:

1. The Standard Conditions of Approval, a copy attached.
2. In addition to any specific erosion control measures described in this order, the applicants shall take all necessary actions to ensure that their activities or those of their agents do not result in noticeable erosion of soils or fugitive dust emissions on the site during the construction and operation of the project covered by this approval.
3. Severability. The invalidity or unenforceability of any provision, or part thereof, of this License shall not affect the remainder of the provision or any other provisions. This License shall be construed and enforced in all respects as if such invalid or unenforceable provision or part thereof had been omitted.
4. The applicants or other responsible party shall, within three months of the expiration of each five-year interval from the date of this Order, submit a report certifying that the items listed in Department Rules, Chapter 500, Appendix B(4) have been completed in accordance with the approved plans.
5. The applicants shall retain their design engineer, or other qualified professional, to inspect the installation of the bio-retention basins, and upon completion, submit a letter to the BLWQ certifying that the structures were installed in accordance with the approved plans.

THIS APPROVAL DOES NOT CONSTITUTE OR SUBSTITUTE FOR ANY OTHER REQUIRED STATE, FEDERAL OR LOCAL APPROVALS NOR DOES IT VERIFY COMPLIANCE WITH ANY APPLICABLE SHORELAND ZONING ORDINANCES.

DEPARTMENT OF ENVIRONMENTAL PROTECTION

PLEASE NOTE THE ATTACHED SHEET FOR GUIDANCE ON APPEAL PROCEDURES...

MR/L#24314BN/ATS#68367

## STORMWATER STANDARD CONDITIONS

### STRICT CONFORMANCE WITH THE STANDARD AND SPECIAL CONDITIONS OF THIS APPROVAL IS NECESSARY FOR THE PROJECT TO MEET THE STATUTORY CRITERIA FOR APPROVAL

**Standard conditions of approval.** Unless otherwise specifically stated in the approval, a department approval is subject to the following standard conditions pursuant to Chapter 500 Stormwater Management Law.

- (1) Approval of variations from plans. The granting of this approval is dependent upon and limited to the proposals and plans contained in the application and supporting documents submitted and affirmed to by the applicant. Any variation from these plans, proposals, and supporting documents must be reviewed and approved by the department prior to implementation. Any variation undertaken without approval of the department is in violation of 38 M.R.S.A. § 420-D(8) and is subject to penalties under 38 M.R.S.A. § 349.
- (2) Compliance with all terms and conditions of approval. The applicant shall submit all reports and information requested by the department demonstrating that the applicant has complied or will comply with all terms and conditions of this approval. All preconstruction terms and conditions must be met before construction begins.
- (3) Advertising. Advertising relating to matters included in this application may not refer to this approval unless it notes that the approval has been granted WITH CONDITIONS, and indicates where copies of those conditions may be obtained.
- (4) Transfer of project. Unless otherwise provided in this approval, the applicant may not sell, lease, assign, or otherwise transfer the project or any portion thereof without written approval by the department where the purpose or consequence of the transfer is to transfer any of the obligations of the developer as incorporated in this approval. Such approval may only be granted if the applicant or transferee demonstrates to the department that the transferee agrees to comply with conditions of this approval and the proposals and plans contained in the application and supporting documents submitted by the applicant. Approval of a transfer of the permit must be applied for no later than two weeks after any transfer of property subject to the license.
- (5) Initiation of project within two years. If the construction or operation of the activity is not begun within two years, this approval shall lapse and the applicant shall reapply to the department for a new approval. The applicant may not begin construction or operation of the project until a new approval is granted. A reapplication for approval may include information submitted in the initial application by reference.
- (6) Reexamination after five years. If the project is not completed within five years from the date of the granting of approval, the department may reexamine its approval and impose additional terms or conditions or prescribe other necessary corrective action to respond to significant changes in circumstances or requirements which may have occurred during the five-year period.
- (7) Certification. Contracts must specify that "all work is to comply with the conditions of the Stormwater Permit." Work done by a contractor or subcontractor pursuant to this approval may not begin before the contractor and any subcontractors have been shown a copy of this approval with the conditions by the developer, and the owner and each contractor and subcontractor has certified, on a form provided by the department, that the approval and conditions



received and read, and that the work will be carried out in accordance with the approval and conditions. Completed certification forms must be forwarded to the department.

- (8) Maintenance. The components of the stormwater management system must be adequately maintained to ensure that the system operates as designed, and as approved by the department.
- (9) Recertification requirement. Within three months of the expiration of each five-year interval from the date of issuance of the permit, the permittee shall certify the following to the department.
  - (a) All areas of the project site have been inspected for areas of erosion, and appropriate steps have been taken to permanently stabilize these areas.
  - (b) All aspects of the stormwater control system have been inspected for damage, wear, and malfunction, and appropriate steps have been taken to repair or replace the facilities.
  - (c) The erosion and stormwater maintenance plan for the site is being implemented as written, or modifications to the plan have been submitted to and approved by the department, and the maintenance log is being maintained

November 16, 2005

# NOTICE OF TERMINATION for use with CONSTRUCTION GENERAL PERMIT

PLEASE TYPE OR PRINT IN **BLACK INK ONLY**

Name of applicant:				Name of owner or lessee:			
Mailing Address:				Town/City:			
State:		Zip Code:		Daytime phone: (with area code)		Email if available:	
Name/description of project:							
				Permit number (if known)			
Name of waterbody(ies) to which the disturbed area drains, or name of municipality if area drains to an MS4:							
Project Location: (Town/City):				UTM Northing: (if known)		UTM Easting: (if known)	
Map #:		Lot #:		County:			

I am filing notice of my Notice of Termination indicating that permanent stabilization has been completed or, if the project was a common plan of development or sale, that the requirements of the Construction General Permit at Part IV(B)(2) have been completed. I have attached all the required submittals. *Notification forms cannot be accepted without the necessary attachments.*

- ALL: Photographs showing the completed project and affected area, except as provided in Part IV(B)(3)(c) of the MCGP.
- IF this form is not being signed by the landowner or lessee of the property, attach documentation showing authorization to sign; OR
- Check here to reference documentation showing authorization to sign that was submitted with the Notice of Intent if the documentation showing authorization to sign applies and is still current.

I authorize staff of the Departments of Environmental Protection to access the project site for the purpose of determining compliance with the general permit.

Signature of Applicant:		Date:	
-------------------------	--	-------	--

*Retain your records.* The permittee is required to retain copies of any forms, submissions, reports, or other materials required by this general permit for a period of at least three years from the completion of permanent stabilization.

OFFICE USE ONLY			Staff	Staff	
NOI #	FP	Date	Acc. Date	Def. Date	After Photos

**GEOTECHNICAL ENGINEERING SERVICES  
PROPOSED K- 5 ELEMENTARY SCHOOL  
OCEAN AVENUE ELEMENTARY SCHOOL  
152 OCEAN AVENUE  
PORTLAND, MAINE**

**07-0234.1**

**May 30, 2008**

**Prepared for:**

City of Portland

Attention: Anita LaChance, Assistant City Manager

389 Congress Street

Portland, Maine 04101

**Prepared by:**



286 Portland Road  
Gray, Maine 04039

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07-0234.1

May 30, 2008

City of Portland  
Attention: Anita LaChance, Assistant City Manager  
389 Congress Street  
Portland, Maine 04101

Subject: Geotechnical Engineering Services  
Proposed K-5 Elementary School  
Ocean Avenue Elementary School  
152 Ocean Avenue  
Portland, Maine

Dear Ms. LaChance:

In accordance with our Agreement, dated April 18, 2008, we have made a subsurface investigation for the proposed K-5 elementary school building at 152 Ocean Avenue in Portland, Maine. This report presents our findings and recommendations and is subject to the limitations presented in Attachment A.

## **1.0 INTRODUCTION**

### **1.1 Scope of Work**

The purpose of our work was to obtain subsurface information in order to develop geotechnical recommendations for foundations and earthwork associated with the proposed construction. Our scope of work included observing and logging test borings and pits, a review of previous geotechnical data, soils lab testing, and preparation of this report.

## **1.2 Proposed Construction**

Based on information provided by Sustainable Design Studio (project civil engineer), we understand that the project will include the construction of a new Elementary School facility, construction of new parking areas and playfields as well as new utilities. We understand that the entire site is on the order of 12 acres which includes the wooded area to the west, the existing Baxter School structure, grounds, and entrances from Walton Street and Ocean Avenue. The new school will be located on the east side of the property, near the existing school.

Based on the information provided on the site plan, we understand the proposed 2-level, T-shaped building will have a footprint on the order of 46,530 square feet and is planned with a slab-on-grade and spread footings. We anticipate the structure will be steel framed with exterior brick veneer. We understand column loads will not exceed 300 kips (total load). We also understand that the finished floor will be between elevation 59.0 and 60.0 feet (project datum).

We understand that new paved parking areas will be constructed on the northerly side of the school and a new bus loop on the easterly side. A playfield is proposed on the west side of the proposed structure. Additionally, subsurface storm-water management areas may be located beneath the proposed paved areas, bus loop and entry plaza.

## **2.0 EXPLORATION AND TESTING**

### **2.1 Exploration**

Fourteen test borings and eight probes were made at the site on April 28, 2008 by Great Works Test Boring of Rollinsford, New Hampshire. Seven test pits were made at the same time by Shaw Brothers Construction of Gorham, Maine. Ten test borings and eight probes were completed in the area of the proposed school building. Two test borings and two test pits were completed in the proposed bus loop and entrance drive and two borings and four test pits were completed in the area of the proposed northerly access drive and parking lot. S. W. COLE ENGINEERING, INC established the exploration locations based on measurements from existing site features and limitations of site access. The approximate locations of the explorations are shown on the "Exploration Location Plan" attached as Sheet 1. Logs of the explorations are attached as Sheets 2 through 25. Ground surface elevations noted on the logs were estimated

based on topographic information shown on Sheet 1. A key to the notes and symbols used on the logs is attached as Sheet 26.

## **2.2 Testing**

Laboratory testing was performed on selected samples from the explorations. Moisture content test results are shown on the logs. The results of six grain size analyses are attached as Sheets 27 to 32.

## **3.0 SITE AND SUBSURFACE CONDITIONS**

### **3.1 Site Conditions**

The site is currently occupied by the existing Baxter School building and the surrounding paved parking areas and driveways. A play field is located to the west of the existing Baxter School building. Driveways are located to the east and northeast of the existing building with access from Ocean Avenue and Walton Street. Surface relief at the site is relatively flat in the areas around the existing building, at an elevation of about 56 feet (project datum). The playfield to the west of the existing building is higher than the area immediately surround the building. The playfield slopes upward from about elevation 56 feet to about elevation 60 feet and is relatively flat towards the tree line to the west.

### **3.2 Subsurface Conditions**

#### **3.2.1 Proposed Building Area**

The subsoils encountered in the test borings in the area of the playfield, the southwest wing of the proposed building (B-101, B-102, B-103, B-106, B-107, B-108, B-109), generally consisted of silty sand with gravel (glacial till) overlying bedrock. The subsoils encountered in the test borings in the areas of the north and east wings of the proposed building (B-104, B-105, B-110, B-111, B-112, B-113, B-114, B-115, B-116, B-119, and B-120) generally consisted of silty sand fill underlain by relatively stiff brown silty clay over silty sand with some gravel (glacial till) overlying bedrock. Bedrock was encountered in the borings at depths of 2.5 to 19.7 below the existing ground surface in the proposed building area.

### **3.2.2 Proposed Access Drives and Bus Loop**

Below the existing pavement and base gravels, soils encountered in the test borings in the area of the proposed access drives and bus loop (B-117, B-118, B-121, and B-122) generally consisted of silty sand with some gravel (glacial till) overlying bedrock. Bedrock was encountered at depths of 3.7 feet to 10 feet below the existing ground surface in the proposed access drives and bus loop.

### **3.2.3 Proposed Parking Areas**

Soils encountered in the explorations in the area of the proposed parking areas generally consisted of silty sand with some gravel (glacial till) overlying bedrock. Bedrock was encountered in boring B-117 at a depth of about 8 feet below the existing ground surface in the proposed parking areas.

Refer to the attached boring and test pit logs for more detailed descriptions of the subsurface findings at the exploration locations.

### **3.3 Groundwater Conditions**

Free groundwater was observed in the complete bore holes at depths varying from about 1.5 to 7 feet below the ground surface in borings B-104, B-105, B-110, B-120, and B-121. Free groundwater was not observed in the other borings at the time of drilling, however, the borings were not left open after completion of drilling to allow groundwater levels to be observed.

Where bedrock was encountered at relatively shallow depths (less than 5 feet) and silty clay is near the surface, it is anticipated that the groundwater may become perched at or near the ground surface seasonally. Groundwater will fluctuate seasonally and during periods of heavy precipitation or snow melt.

### **3.4 Seismic and Frost Conditions**

According to the 2006 International Building Code, we interpret the subsurface conditions encountered in the explorations to correspond to a seismic soil Site Class D (N-value method). The design freezing index for the Portland, Maine area is about 1,250-Fahrenheit-degree-days, which corresponds to a frost penetration depth on the order of 4.5 feet.



## **4.0 EVALUATIONS AND RECOMMENDATIONS**

### **4.1 General Findings**

Based on the subsurface findings and our understanding of the proposed construction, it is our opinion that the site is suitable for the proposed construction from a geotechnical standpoint. Specifically, the structure can be supported on spread footing foundations that are founded on at least 6 inches of compacted Crushed Stone overlying bedrock, undisturbed native soils, or new compacted fill. A layer of geotextile fabric is recommended below the crushed stone layer overlying soil subgrades.

Based on the existing topographic information and the proposed finish floor elevations, it appears the majority of the proposed school building area will require new compacted tapered fills approaching 6 feet to achieve grades. Consideration should be given to sequencing the construction so that the fills are placed as soon as possible in the proposed building area. It is recommended that construction of footings and foundation walls begin in the area where bedrock is shallow and continue along the building lines from shallower bedrock to deeper bedrock areas. This will allow the native silty clay soils to re-consolidate and reduce the possibility of post-construction settlement.

Shallow refusal surfaces, presumed to be bedrock, were encountered primarily in the southwest portion of the site. Shallow refusal surfaces (less than 6± feet below the ground surface) were encountered at borings B-101, B-102, B-103, B-104, B-107, B-108, and B-109. Sufficient bedrock will need to be removed below footing, slab and paved areas to allow for a choke stone layer and base/subbase materials. In general, bedrock should be removed to at least 6 inches below footings, and at least 24 inches below the bottom of slabs and pavements.

### **4.2 Excavation**

Based on the existing topographic information and proposed finish floor elevations, it appears that a majority of the site will require fills to achieve grades. A cut will be needed in the northwest and southwest wings of the building where shallow bedrock was encountered. Although proposed exterior grading information is not available at this time, we anticipate that some fills will be needed along the new access road, bus loop, parking areas and the west playfield.

Based on the findings at the explorations, groundwater may be encountered near subgrade elevation in foundation and utility excavations, particularly where shallow bedrock is encountered. Precipitation may become ponded on the silty clay or bedrock during construction. The contractor should be prepared to dewater excavations, as needed. Sumping and pumping dewatering techniques from the 6" stone layer should be adequate to control groundwater in foundation excavations. More extensive dewatering techniques may be required for utility excavations depending on the depth of utilities. Controlling the water levels to at least 6 inches below subgrade elevations will help stabilize the subgrade and provide a more suitable working surface during construction.

Precipitation can make the soils difficult to work, thus, the subgrade should not be exposed any longer than necessary. Should the subgrade become loose, soft or difficult to work, we recommend that unsuitable soils be removed and replaced with compacted crushed stone underlain by a woven geotextile fabric.

Excavations must be properly shored and/or sloped to prevent sloughing and caving of the sidewalls during construction. Temporary, unsupported soil excavations should be sloped back to 1V: to 1 ½ H or flatter. All excavations should be consistent with OSHA trenching regulations.

Bedrock removal by blasting should be anticipated in the southwest and northwest wings of the proposed building. A detailed blasting plan should be prepared prior to blasting construction. We recommend that an experienced drilling and blasting contractor be engaged to complete the rock removal and that the contractor be required to submit qualifications and references prior to the excavation. The depth of blast must be controlled to prevent potentially adverse overblast. All loose rock must be removed to expose sound, intact bedrock prior to placing the choke stone material on top of blasted surfaces.

S. W. COLE ENGINEERING, INC. should be on site during excavation and blasting work to observe subgrade conditions and grading activities.

### **4.3 Site and Subgrade Preparation**

We recommend that site preparation begin with the construction of an erosion control system to protect adjacent drainage ways and areas outside the construction limits. As much vegetation as possible, should remain undisturbed adjacent to the construction site to lessen the potential for erosion. All topsoil and organic soils (including tree roots), subsurface structures (including existing foundations and other structures), underground utilities, and fill soils should be removed from areas of construction.

We recommend that fill used to raise building and paved areas consist of sand and gravel meeting the requirements of MDOT Standard Specifications 703.19 Granular Borrow. We recommend foundation subgrade preparation consist of over-excavating below all footings at least 6 inches and placing at least 6 inches of compacted Crushed Stone. The crushed stone should be underlain by a woven geotextile for soil subgrades. For bedrock subgrades the crushed stone should be worked into fractures to fill any voids. The width of the Crushed Stone layer should extend at least 12 inches beyond the edges of the proposed footings for each 12 inches of overexcavation (1H to 1V bearing splay). For slab areas, we recommend excavating at least 12 inches below bottom of slab elevation to allow for the slab base aggregate (see section 4.6). If bedrock is encountered, we recommend removing bedrock to at least 24 inches below bottom of slab. Where bedrock is removed to achieve subgrade elevations, a 4 to 6 inch thick layer of crushed stone should be worked into fractured bedrock prior to placing any Granular Borrow or Structural Fill.

S. W. COLE ENGINEERING, INC. should be on-site during earthwork activity to observe subgrade suitability prior to placing any new fills, geotextile fabric, crushed stone, or concrete.

### **4.4 Foundation Design**

The proposed structure can derive support from spread footings founded on at least 6 inches of compacted crushed stone overlying a woven geotextile over soil subgrades or 6 inches of crushed stone overlying bedrock. Exterior perimeter footings will need to be cast at least 4.5 feet below exterior finish grade to provide frost protection. For footings bearing on properly prepared subgrades, we recommend the following geotechnical parameters for design of spread footings:

- Allowable Soil Bearing Pressure 3.0 ksf (Compacted Crushed Stone)
- Design Frost Depth 4.5 feet
- Seismic Soil Site Class (IBC 2006) D
- Base Friction Factor 0.4 (Mass Concrete to Crushed Stone)
- Passive Lateral Earth Pressure Coefficient ( $K_p$ ) 3.0 (Structural Fill)
- Active Lateral Earth Pressure Coefficient ( $K_a$ ) 0.3 (Structural Fill)
- At-Rest Lateral Earth Pressure Coefficient ( $K_o$ ) 0.5 (Structural Fill)
- Total Unit Weight of Backfill ( $\gamma_t$ ) 130 pcf (Structural Fill)
- Internal Friction Angle ( $\phi$ ) 30 degrees (Structural Fill)

Wall footings should be at least 18 inches wide and column footings at least 24 inches in their smallest lateral dimension. Foundation and retaining walls restrained from rotation should be designed considering at-rest lateral earth pressures.

#### **4.5 Foundation Drainage**

We recommend that a perimeter foundation drainage system be provided for the structure. Foundation drains should be placed in the crushed stone outside of the perimeter footings. Rigid, 4 inch diameter SDR-35 foundation drainpipes should be utilized. The foundation drain pipe should be wrapped with filter fabric and be enveloped with at least 6 inches of crushed stone bedding. The foundation drainage system must have several positive gravity outlets.

Exterior foundation backfill should be sealed with a surficial layer of clayey or loamy soil in areas that are not to be paved or occupied by entrance slabs. This is to reduce direct surface water infiltration into the backfill. Ideally, surface grades should be sloped away from the building for positive surface water drainage.

#### **4.6 Floor Slabs**

Slab-on-grade floors in heated areas may be designed using a subgrade reaction modulus of 150 pci (pounds per cubic inch) provided the slab is underlain by at least 12 inches of Structural Fill overlying properly prepared subgrades. Geotextile fabric may be needed below the Structural Fill in some slab areas depending upon soil and moisture conditions. We recommend that control joints be installed within the floor slab to accommodate shrinkage in the concrete as it cures. In general, construction joints

are typically installed at 10 to 15 foot spacing, but actual spacing should be determined by the structural engineer with consideration to slab thickness.

A vapor retarder should underlie floor slabs to limit the upward migration of moisture vapors. The vapor retarder should have a permeance that is less than the floor covering being applied on the slab. We recommend consulting flooring manufacturers relative to selection and installation of acceptable vapor retarder systems for use with their products.

Floor slabs should be wet-cured for a period of least 7 days after casting as a measure to reduce the potential for curling of the concrete and excessive drying/shrinkage. After the initial wet-cure period, we recommend that consideration be given to using curing paper installed over the cast-in-place concrete and that the curing paper remain in place as long as possible to improve the quality of the completed floor. In lieu of curing paper, a curing compound may be utilized; however, care must be taken to prevent scuffing of the compound from the floor during the curing period.

Based on the subsurface findings and our understanding of the proposed construction, areas of the proposed building will be underlain by shallow bedrock. Although not in our scope, we recommend that the owner and architect consider a passive sub-slab radon venting system beneath the proposed slab-on-grade floors. Additionally, the ventilation system for the proposed building should be designed to encourage positive air pressurization of the building to help further control intrusion of soil-gas and radon. Design of a sub-slab vent system may require changes to the recommendations in this report. We can assist with design of a sub-slab vent system, if needed.

#### **4.7 Exterior Slabs and Sidewalks**

Entrance slabs and sidewalks should be designed to reduce the effects of differential frost action between doorways and entrances. We recommend that excavations beneath the entire length and width of entrances, sidewalks, and exterior slabs adjacent to the building continue to at least 4.5 feet below finish grade. These areas should be backfilled with compacted non-frost susceptible Structural Fill to help limit abrupt heave or differential movement. The zone of non-frost susceptible material below entrance slabs and sidewalks should transition up to adjacent sidewalk or pavement subbase at a 3H:1V slope or flatter.

#### **4.8 Pavements**

Although traffic loading information was not made available to us, we anticipate traffic loading to consist of passenger vehicles, buses and light delivery vehicles. Thus, we offer the following pavement sections based on our experience with similar construction.

<b>FLEXIBLE (ASPHALT) PAVEMENT</b>		
Pavement Layer	Standard Duty	Heavy Duty
Maine DOT 9.5 mm Superpave, (Standard Specifications for Highways and Bridges)	1.25 inches	1.25 inches
Maine DOT 19.0 mm Superpave, (Standard Specifications for Highways and Bridges)	2.25 inches	2.75 inches
Maine DOT Crushed Aggregate Base 703.06 Type A, (Standard Specifications for Highways and Bridges)	6 inches	6 inches
Maine DOT Aggregate Subbase 703.06 Type D, (Standard Specifications for Highways and Bridges)	12 inches	18 inches
Geotextile Fabric over soil subgrades (Mirafi 500X)	YES	YES

The bituminous pavement should be compacted to 92 to 97 percent of its theoretical maximum density as determined by ASTM D-2041. Tack coat should be applied between successive lifts of asphalt. The base and subbase materials should be compacted to at least 95 percent of their maximum dry densities as determined by ASTM D-1557. Fill placed below the subbase material be compacted to at least 95 percent of ASTM D-1557.

Consideration should be given to the development of both surface and subsurface drainage. The paved areas should be graded to promote surface drainage away from the building area and design should consider sloping of the subgrade to enhance drainage of pavement gravels.

Frost penetration can be on the order of 4.5 feet or more in this area of the state. In the absence of full depth excavation of frost susceptible soils or use of insulation, frost will penetrate into the subgrade and some frost heaving and pavement distress must be anticipated.

#### **4.9 Backfill and Compaction**

The on-site soils are frost susceptible and are not suitable for re-use in the proposed building, access drives, or parking areas. On-site soils may be suitable for re-use as common fill in landscaped areas. This material, if re-used, should be segregated and stockpiled during construction and grain-size analyses should be performed to determine their suitability for re-use on-site. Re-use suitability will also be dependent on gradation and in-situ moisture content. The soil must have a moisture content acceptable for achieving project compaction requirements. Soils may require drying prior to re-use and silty soils may be difficult to re-use in freezing and wet weather.

Granular Borrow used to raise building and pavement area subgrades should meet the requirements of MDOT Standard Specifications 703.19.

Structural Fill used to backfill foundations, below floor slabs, and below entrance slabs and sidewalks should be a clean, non-frost susceptible sand and gravel meeting the following gradation requirements:

<b>Structural Fill</b>	
Sieve Size	Percent Finer by Weight
4 inch	100
3 inch	90 to 100
¼ inch	25 to 90
No. 40	0 to 30
No. 200	0 to 5

Crushed Stone for use below footings and as a choke stone over fractured bedrock should meet the following gradation:

<b>Crushed Stone</b>	
<b>Sieve Size</b>	<b>Percent Finer by Weight</b>
1 inch	100
3/4 inch	90 to 100
3/8 inch	0 to 75
No. 4	0 to 25
No. 200	0 to 5

Fill and backfill should be placed in horizontal lifts and be compacted such that desired density is achieved throughout the lift thickness with 3 to 5 passes of the compaction equipment. We recommend that the loose lift thickness for soil fills not exceed 12 inches. Fills within the proposed building and paved areas should be compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557. Fills placed within landscape areas should be compacted to at least 92 percent of its maximum dry density.

#### **4.10 Subsurface Storm Water Disposal**

The subsoils in the borings and test pits in the areas of the proposed subsurface storm water disposal areas generally consisted of silt and sand with some clay. The permeability of the site soils was estimated using the grain size results and Hazen's formula. The estimated permeability of the on-site soils was in the range of  $10^{-4}$  to  $10^{-5}$  centimeters per second.

#### **4.11 Design Review and Construction Testing**

S. W. COLE ENGINEERING, INC. should be retained to review the final design and specifications to determine that our earthwork and foundation recommendations have been properly interpreted and implemented.

A quality assurance testing program should also be implemented during construction to observe compliance with the design concepts, plans, and specifications. S. W. COLE ENGINEERING, INC. is available to provide field and laboratory testing services for soil, concrete, masonry, steel, spray-applied fireproofing, and asphalt construction materials.



**5.0 CLOSURE**

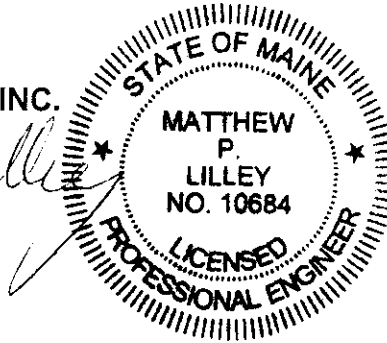
It has been a pleasure to be of assistance to you with this phase of your project. If you have any questions, please do not hesitate to contact us.

Sincerely,

**S. W. COLE ENGINEERING, INC.**

*Matthew P. Lilley*

Matthew P. Lilley, P. E.  
Geotechnical Engineer



c: Sustainable Design Studio – Ann Archino-Howe

MPL:mpl/jlw

## **Attachment A**

### **Limitations**

This report has been prepared for the exclusive use by the City of Portland for specific application to the Proposed K-5 Elementary School at 152 Ocean Avenue in Portland, Maine. S. W. COLE ENGINEERING, INC. has endeavored to conduct the work in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

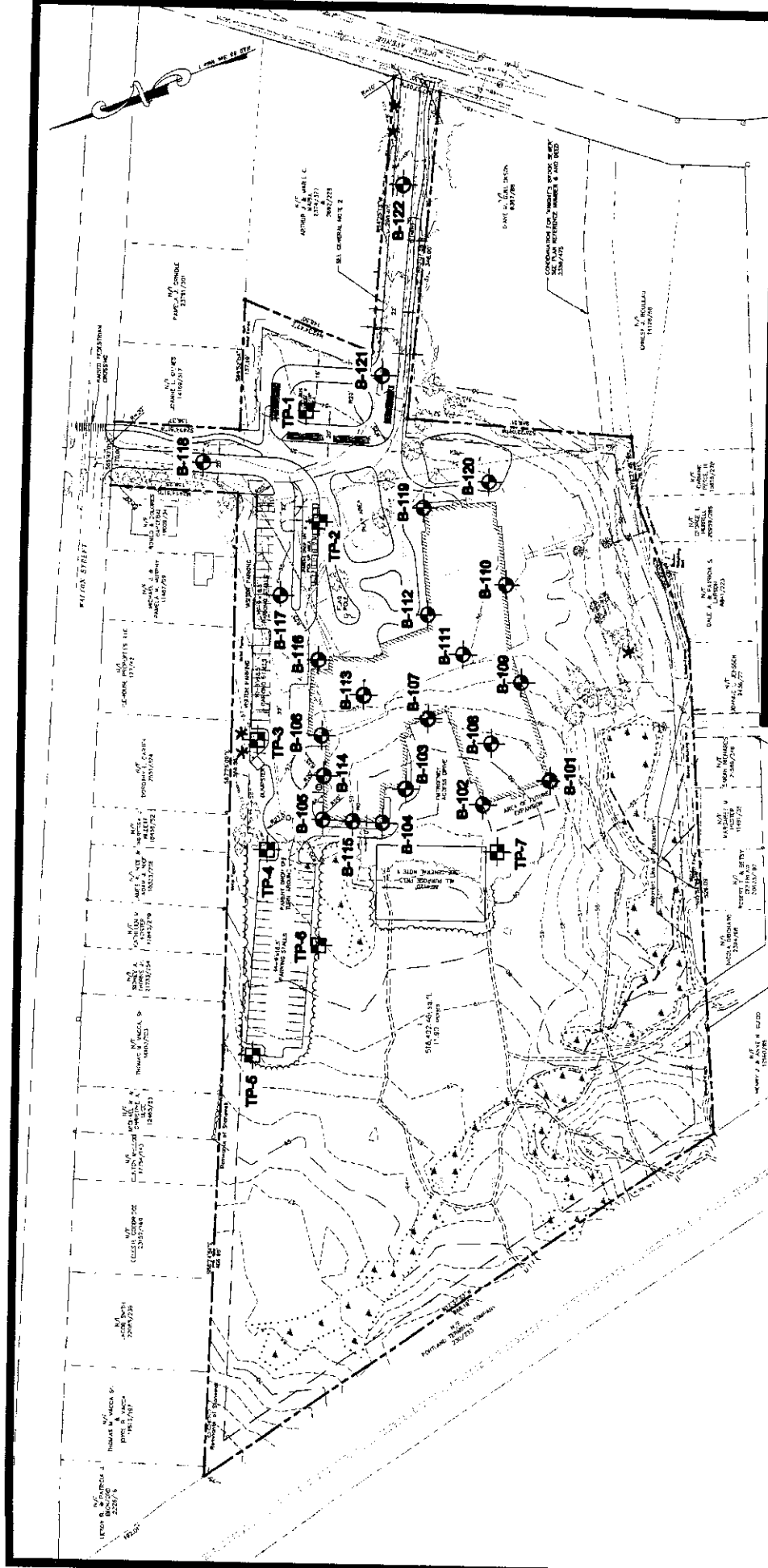
The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

The analyses performed during this investigation and recommendations presented in this report are based in part upon the data obtained from subsurface explorations made at the site. Variations in subsurface conditions may occur between explorations and may not become evident until construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and to review the recommendations of this report.

Observations have been made during exploration work to assess site groundwater levels. Fluctuations in water levels will occur due to variations in rainfall, temperature, and other factors.

S. W. COLE ENGINEERING, INC.'s scope of work has not included the investigation, detection, or prevention of any Biological Pollutants at the project site or in any existing or proposed structure at the site. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and the byproducts of any such biological organisms.

Recommendations contained in this report are based substantially upon information provided by others regarding the proposed project. In the event that any changes are made in the design, nature, or location of the proposed project, S. W. COLE ENGINEERING, INC. should review such changes as they relate to analyses associated with this report. Recommendations contained in this report shall not be considered valid unless the changes are reviewed by S. W. COLE ENGINEERING, INC.



CITY OF PORTLAND

**EXPLORATION LOCATION PLAN**  
 PROPOSED K-5 ELEMENTARY SCHOOL  
 152 OCEAN AVENUE  
 PORTLAND, MAINE

**LEGEND**  
 APPROXIMATE BORING LOCATION  
 APPROXIMATE TEST PIT LOCATION

**NOTE:**

BASE PLAN PROVIDED BY SUSTAINABLE DESIGN STUDIO.

Job No. 07-0234.1 S  
 Date: 05/27/08

Scale NOT TO SCALE  
 Sheet 1









# BORING LOG

BORING NO.: **B-104**  
 SHEET: **1 OF 1**  
 PROJECT NO.: **07-0234.1 S**  
 DATE START: **4/28/2008**  
 DATE FINISH: **4/28/2008**  
 ELEVATION: **61' +/-**  
 SWC REP.: **MPL**

PROJECT: PROPOSED ELEMENTARY SCHOOL  
 CLIENT: CITY OF PORTLAND  
 LOCATION: WALTON AND OCEAN STREETS, PORTLAND, MAINE  
 DRILLING FIRM: GREAT WORKS TEST BORING DRILLER: PETE MICHAUD  
 TYPE: \_\_\_\_\_ SIZE I.D.: \_\_\_\_\_ HAMMER WT.: \_\_\_\_\_ HAMMER FALL: \_\_\_\_\_  
 CASING: SSA 4 1/4"  
 SAMPLER: SS 2 3/8" 140 lb 30"  
 CORE BARREL: \_\_\_\_\_

**WATER LEVEL INFORMATION**  
 GROUNDWATER AT 5.0'

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
	1D	24"	24"	2.0'	5	4	3	4	0.4'	TOPSOIL ~LOOSE~ SILTY CLAYEY SAND, TRACE GRAVEL
									4.0' 5.0'	----- BECOMES GRAY AND WET
	2D	24"	24"	7.0'	3	5	7	10	10.0'	GRAY TO TAN SILTY CLAY, TRACE SAND ~STIFF~
	3D	24"	24"	12.0'	9	9	6	7	12.0'	BROWN SILTY SAND ~MEDIUM DENSE~
	4D	0"	0"	15.0'	25/0"				15.0'	GRAY SILTY CLAY ~STIFF~ REFUSAL @ 15.0 FEET (PROBABLE BEDROCK)

SAMPLES: \_\_\_\_\_ SOIL CLASSIFIED BY: \_\_\_\_\_  
 D = SPLIT SPOON  DRILLER - VISUALLY  
 C = 3" SHELBY TUBE  SOIL TECH. - VISUALLY  
 U = 3.5" SHELBY TUBE  LABORATORY TEST

REMARKS: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.



# BORING LOG

BORING NO.: **B-105**  
 SHEET: **1 OF 1**  
 PROJECT NO.: **07-0234.1 S**  
 DATE START: **4/28/2008**  
 DATE FINISH: **4/28/2008**  
 ELEVATION: **58.5' +/-**  
 SWC REP.: **MPL**

PROJECT: **PROPOSED ELEMENTARY SCHOOL**  
 CLIENT: **CITY OF PORTLAND**  
 LOCATION: **WALTON AND OCEAN STREETS, PORTLAND, MAINE**  
 DRILLING FIRM: **GREAT WORKS TEST BORING** DRILLER: **PETE MICHAUD**  
 TYPE: **SSA** SIZE I.D.: **4 1/4"** HAMMER WT.: **140 lb** HAMMER FALL: **30"**  
 CASING: **SS**  
 SAMPLER: **SS**  
 CORE BARREL:

**WATER LEVEL INFORMATION**  
 GROUNDWATER AT 3.5'

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
	1D	24"	14"	2.0'	1	2	2	1	0.1'	TOPSOIL
									0.5'	TAN SAND (FILL)
									0.6'	RELIC TOPSOIL
									4.0'	~ LOOSE ~ GRAY SILTY SAND
	2D	24"	22"	7.0'	6	12	15	18		BROWN SILTY SAND ~MEDIUM DENSE~
									11.0'	
	3D	24"	24"	12.0'	5	15	17	9	13.0'	GRAY SANDY SILTY CLAY ~ STIFF ~
	4D	24"	24"	17.0'	1/12"		1/12"		19.5'	GRAY SILTY SANDY CLAY ~VERY SOFT~
										REFUSAL @ 19.5 FEET (PROBABLE BEDROCK)

SAMPLES: D = SPLIT SPOON  
 C = 3" SHELBY TUBE  
 U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:  DRILLER - VISUALLY  
 SOIL TECH. - VISUALLY  
 LABORATORY TEST

REMARKS: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.













# BORING LOG

BORING NO.: B-110  
 SHEET: 1 OF 1  
 PROJECT NO.: 07-0234.1 S  
 DATE START: 4/28/2008  
 DATE FINISH: 4/28/2008  
 ELEVATION: 56' +/-  
 SWC REP.: MPL

PROJECT: PROPOSED ELEMENTARY SCHOOL  
 CLIENT: CITY OF PORTLAND  
 LOCATION: WALTON AND OCEAN STREETS, PORTLAND, MAINE  
 DRILLING FIRM: GREAT WORKS TEST BORING DRILLER: PETE MICHAUD  
 TYPE: SSA SIZE I.D.: 4 1/4" HAMMER WT: 140 lb HAMMER FALL: 30"  
 CASING: SSA SIZE I.D.: 4 1/4"  
 SAMPLER: SS SIZE I.D.: 2 3/8" HAMMER WT: 140 lb HAMMER FALL: 30"  
 CORE BARREL: \_\_\_\_\_

**WATER LEVEL INFORMATION**

GROUNDWATER AT 7.0'

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
									0.2'	ASPHALT PAVEMENT
	1D	24"	15"	3.0'	3	1	1	2	1.5'	BLACK SILTY SAND, SOME GRAVEL (FILL)
										OLIVE BROWN SILTY CLAY ~STIFF~
	2D	24"	24"	7.0'	4	6	6	7		
									11.5'	
	3D	24"	24"	12.0'	1	2	3	4	13.5'	~ LOOSE ~ BROWN SILTY SAND, WET
										GRAY SILTY SANDY CLAY ~VERY SOFT~
	4D	24"	24"	17.0'	WOH/24"				19.7'	
										REFUSAL @ 19.7 FEET (PROBABLE BEDROCK)

SAMPLES: D = SPLIT SPOON  
 C = 3" SHELBY TUBE  
 U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:  DRILLER - VISUALLY  
 SOIL TECH. - VISUALLY  
 LABORATORY TEST

REMARKS: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.



# BORING LOG

BORING NO.: **B-111**  
 SHEET: 1 OF 1  
 PROJECT NO.: 07-0234.1 S  
 DATE START: 4/28/2008  
 DATE FINISH: 4/28/2008  
 ELEVATION: 56' +/-  
 SWC REP.: MPL

PROJECT: PROPOSED ELEMENTARY SCHOOL  
 CLIENT: CITY OF PORTLAND  
 LOCATION: WALTON AND OCEAN STREETS, PORTLAND, MAINE  
 DRILLING FIRM: GREAT WORKS TEST BORING DRILLER: PETE MICHAUD  
 TYPE: SSA SIZE I.D.: 4 1/4" HAMMER WT.:            HAMMER FALL:             
 CASING:             
 SAMPLER:             
 CORE BARREL:           

**WATER LEVEL INFORMATION**

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
									0.2'	ASPHALT PAVEMENT
									1.0'	SILTY SAND, SOME GRAVEL (FILL)
									10.5'	OLIVE BROWN SILTY CLAY
									13.0'	PROBABLE SAND
										REFUSAL @ 13.0 FEET (PROBABLE BEDROCK)

SAMPLES: D = SPLIT SPOON  
 C = 3" SHELBY TUBE  
 U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:  DRILLER - VISUALLY  
 SOIL TECH. - VISUALLY  
 LABORATORY TEST

REMARKS: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.



# BORING LOG

BORING NO.: **B-112**  
 SHEET: 1 OF 1  
 PROJECT NO.: 07-0234.1 S  
 DATE START: 4/28/2008  
 DATE FINISH: 4/28/2008  
 ELEVATION: 56' +/-  
 SWC REP.: MPL

PROJECT: PROPOSED ELEMENTARY SCHOOL  
 CLIENT: CITY OF PORTLAND  
 LOCATION: WALTON AND OCEAN STREETS, PORTLAND, MAINE  
 DRILLING FIRM: GREAT WORKS TEST BORING DRILLER: PETE MICHAUD  
 CASING: TYPE SSA SIZE I.D. 4 1/4" HAMMER WT. HAMMER FALL  
 SAMPLER: SS 2 3/8" 140 lb 30"  
 CORE BARREL:

### WATER LEVEL INFORMATION

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
									0.2'	ASPHALT PAVEMENT
	1D	24"	14"	2.5'	3	3	3	4	1.0'	BLACK SILTY SAND, TRACE GRAVEL (FILL) ~MEDIUM STIFF~
	2D	24"	24"	7.0'	4	5	7	13	8.5'	OLIVE BROWN SILTY CLAY (MOTTLED) ~STIFF~
	3D	24"	24"	12.0'	1	1	2	7	11.5'	GRAY SILTY CLAY ~ MEDIUM ~
									15.0'	BROWN SILTY SAND ~ LOOSE ~
										REFUSAL @ 15.0 FEET (PROBABLE BEDROCK)

SAMPLES: SOIL CLASSIFIED BY:  
 D = SPLIT SPOON  
 C = 3" SHELBY TUBE  
 U = 3.5" SHELBY TUBE  
 DRILLER - VISUALLY  
 SOIL TECH. - VISUALLY  
 LABORATORY TEST

REMARKS:  
 STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.



# BORING LOG

BORING NO.: **B-113**  
 SHEET: 1 OF 1  
 PROJECT NO.: 07-0234.1 S  
 DATE START: 4/28/2008  
 DATE FINISH: 4/28/2008  
 ELEVATION: 57' +/-  
 SWC REP.: MPL

PROJECT: PROPOSED ELEMENTARY SCHOOL  
 CLIENT: CITY OF PORTLAND  
 LOCATION: WALTON AND OCEAN STREETS, PORTLAND, MAINE  
 DRILLING FIRM: GREAT WORKS TEST BORING DRILLER: PETE MICHAUD  
 TYPE: SSA SIZE I.D.: 4 1/4" HAMMER WT.: HAMMER FALL  
 CASING: \_\_\_\_\_  
 SAMPLER: \_\_\_\_\_  
 CORE BARREL: \_\_\_\_\_

### WATER LEVEL INFORMATION

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
									0.2'	ASPHALT PAVEMENT
									1.0'	BROWN SILTY SAND (FILL)
									8.0'	BROWN SANDY SILT / SILTY SAND
										REFUSAL @ 8.0 FEET (PROBABLE BEDROCK)

SAMPLES: SOIL CLASSIFIED BY: REMARKS:

D = SPLIT SPOON  
 C = 3" SHELBY TUBE  
 U = 3.5" SHELBY TUBE

DRILLER - VISUALLY  
 SOIL TECH. - VISUALLY  
 LABORATORY TEST

STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

(14)

BORING NO.: **B-113**





# BORING LOG

BORING NO.: B-114  
 SHEET: 1 OF 1  
 PROJECT NO.: 07-0234.1 S  
 DATE START: 4/28/2008  
 DATE FINISH: 4/28/2008  
 ELEVATION: 58' +/-  
 SWC REP.: MPL

PROJECT: PROPOSED ELEMENTARY SCHOOL  
 CLIENT: CITY OF PORTLAND  
 LOCATION: WALTON AND OCEAN STREETS, PORTLAND, MAINE  
 DRILLING FIRM: GREAT WORKS TEST BORING DRILLER: PETE MICHAUD  
 TYPE: SSA SIZE I.D.: 4 1/4" HAMMER WT.: HAMMER FALL  
 CASING: \_\_\_\_\_  
 SAMPLER: \_\_\_\_\_  
 CORE BARREL: \_\_\_\_\_

### WATER LEVEL INFORMATION

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
									0.3'	TOPSOIL
										BROWN SILTY SAND
									9.0'	
										GRAY SILTY CLAY
									17.0'	
										REFUSAL @ 17.0 FEET (PROBABLE BEDROCK)

SAMPLES: \_\_\_\_\_ SOIL CLASSIFIED BY: \_\_\_\_\_  
 D = SPLIT SPOON  DRILLER - VISUALLY  
 C = 3" SHELBY TUBE  SOIL TECH. - VISUALLY  
 U = 3.5" SHELBY TUBE  LABORATORY TEST

REMARKS: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.  
 (15)  
 BORING NO.: B-114



# BORING LOG

BORING NO.: B-115  
 SHEET: 1 OF 1  
 PROJECT NO.: 07-0234.1 S  
 DATE START: 4/28/2008  
 DATE FINISH: 4/28/2008  
 ELEVATION: 59' +/-  
 SWC REP.: MPL

PROJECT: PROPOSED ELEMENTARY SCHOOL  
 CLIENT: CITY OF PORTLAND  
 LOCATION: WALTON AND OCEAN STREETS, PORTLAND, MAINE  
 DRILLING FIRM: GREAT WORKS TEST BORING DRILLER: PETE MICHAUD  
 TYPE: \_\_\_\_\_ SIZE I.D.: \_\_\_\_\_ HAMMER WT.: \_\_\_\_\_ HAMMER FALL: \_\_\_\_\_  
 CASING: SSA 4 1/4"  
 SAMPLER: \_\_\_\_\_  
 CORE BARREL: \_\_\_\_\_

**WATER LEVEL INFORMATION**

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
									0.3'	TOPSOIL
										BROWN SILTY SAND
									12.0'	
										GRAY SILTY CLAY
									17.5'	
									19.5'	WEATHERED BEDROCK
										REFUSAL @ 19.5 FEET (PROBABLE BEDROCK)

SAMPLES: \_\_\_\_\_ SOIL CLASSIFIED BY: \_\_\_\_\_ REMARKS: \_\_\_\_\_

D = SPLIT SPOON  
 C = 3" SHELBY TUBE  
 U = 3.5" SHELBY TUBE

DRILLER - VISUALLY  
 SOIL TECH. - VISUALLY  
 LABORATORY TEST

STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

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BORING NO.: **B-115**



# BORING LOG

BORING NO.: B-116  
 SHEET: 1 OF 1  
 PROJECT NO.: 07-0234.1 S  
 DATE START: 4/28/2008  
 DATE FINISH: 4/28/2008  
 ELEVATION: 56' +/-  
 SWC REP.: MPL

PROJECT: PROPOSED ELEMENTARY SCHOOL  
 CLIENT: CITY OF PORTLAND  
 LOCATION: WALTON AND OCEAN STREETS, PORTLAND, MAINE  
 DRILLING FIRM: GREAT WORKS TEST BORING DRILLER: PETE MICHAUD  
 TYPE: \_\_\_\_\_ SIZE I.D.: \_\_\_\_\_ HAMMER WT.: \_\_\_\_\_ HAMMER FALL: \_\_\_\_\_  
 CASING: SSA 4 1/4"  
 SAMPLER: SS 2 3/8" 140 lb 30"  
 CORE BARREL: \_\_\_\_\_

## WATER LEVEL INFORMATION

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
									0.2'	ASPHALT PAVEMENT
	1D	24"	6"	2.5'	6	9	10	8	1.0'	BROWN SILTY SAND, SOME GRAVEL (FILL) ~VERY STIFF~ OLIVE BROWN SILTY CLAY
									6.0'	
	2D	24"	22"	7.0'	5	6	15	23	7.3'	~ DENSE ~ BROWN SILTY SAND, SOME GRAVEL
										REFUSAL @ 7.3 FEET (PROBABLE BEDROCK)

SAMPLES: \_\_\_\_\_ SOIL CLASSIFIED BY: \_\_\_\_\_  
 D = SPLIT SPOON  DRILLER - VISUALLY  
 C = 3" SHELBY TUBE  SOIL TECH. - VISUALLY  
 U = 3.5" SHELBY TUBE  LABORATORY TEST

REMARKS: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.





# BORING LOG

BORING NO.: B-118  
 SHEET: 1 OF 1  
 PROJECT NO.: 07-0234.1 S  
 DATE START: 4/28/2008  
 DATE FINISH: 4/28/2008  
 ELEVATION: 55.5' +/-  
 SWC REP.: MPL

PROJECT: PROPOSED ELEMENTARY SCHOOL  
 CLIENT: CITY OF PORTLAND  
 LOCATION: WALTON AND OCEAN STREETS, PORTLAND, MAINE  
 DRILLING FIRM: GREAT WORKS TEST BORING DRILLER: PETE MICHAUD  
 TYPE: \_\_\_\_\_ SIZE I.D. \_\_\_\_\_ HAMMER WT. \_\_\_\_\_ HAMMER FALL \_\_\_\_\_  
 CASING: SSA 4 1/4"  
 SAMPLER: SS 2 3/8" 140 lb 30"  
 CORE BARREL: \_\_\_\_\_

### WATER LEVEL INFORMATION

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
									0.2'	ASPHALT PAVEMENT
									1.5'	BROWN SILTY SAND, SOME GRAVEL (FILL)
	1D	24"	24"	4.0'	3	3	4	5		BROWN SILTY CLAY -MEDIUM STIFF-
	2D	24"	24"	7.0'	4	4	6	10	7.0'	
									9.5'	PROBABLE SAND
										REFUSAL @ 9.5 FEET (PROBABLE BEDROCK)

SAMPLES: \_\_\_\_\_ SOIL CLASSIFIED BY: \_\_\_\_\_  
 D = SPLIT SPOON  DRILLER - VISUALLY  
 C = 3" SHELBY TUBE  SOIL TECH. - VISUALLY  
 U = 3.5" SHELBY TUBE  LABORATORY TEST

REMARKS: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.







# BORING LOG

BORING NO.: B-121  
 SHEET: 1 OF 1  
 PROJECT NO.: 07-0234.1 S  
 DATE START: 4/28/2008  
 DATE FINISH: 4/28/2008  
 ELEVATION: 53' +/-  
 SWC REP.: MPL

PROJECT: PROPOSED ELEMENTARY SCHOOL  
 CLIENT: CITY OF PORTLAND  
 LOCATION: WALTON AND OCEAN STREETS, PORTLAND, MAINE  
 DRILLING FIRM: GREAT WORKS TEST BORING DRILLER: PETE MICHAUD  
 TYPE: SSA SIZE I.D.: 4 1/4" HAMMER WT.: 140 lb HAMMER FALL: 30"  
 CASING: SSA SIZE I.D.: 4 1/4"  
 SAMPLER: SS SIZE I.D.: 2 3/8" HAMMER WT.: 140 lb HAMMER FALL: 30"  
 CORE BARREL: \_\_\_\_\_

**WATER LEVEL INFORMATION**  
 GROUNDWATER AT 1.5'

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
									0.2'	ASPHALT PAVEMENT
									1.6'	BROWN SILTY SAND, SOME GRAVEL (FILL)
	1D	24"	19"	4.0'	5	2	1	4	3.0'	~ LOOSE ~ BROWN SILTY SAND
	2D	24"	24"	7.0'	3	4	4	7	7.5'	BROWN SILTY CLAY ~MEDIUM STIFF~
										REFUSAL @ 7.5 FEET (PROBABLE BEDROCK)

SAMPLES: D = SPLIT SPOON  
 C = 3" SHELBY TUBE  
 U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:  DRILLER - VISUALLY  
 SOIL TECH. - VISUALLY  
 LABORATORY TEST

REMARKS: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.





# BORING LOG

BORING NO.: B-122  
 SHEET: 1 OF 1  
 PROJECT NO.: 07-0234.1 S  
 DATE START: 4/28/2008  
 DATE FINISH: 4/28/2008  
 ELEVATION: 49.5' +/-  
 SWC REP.: MPL

PROJECT: PROPOSED ELEMENTARY SCHOOL  
 CLIENT: CITY OF PORTLAND  
 LOCATION: WALTON AND OCEAN STREETS, PORTLAND, MAINE  
 DRILLING FIRM: GREAT WORKS TEST BORING DRILLER: PETE MICHAUD  
 TYPE: SSA SIZE I.D.: 4 1/4" HAMMER WT.: 140 lb HAMMER FALL: 30"  
 CASING: SS  
 SAMPLER: SS  
 CORE BARREL: \_\_\_\_\_

**WATER LEVEL INFORMATION**  
 GROUNDWATER AT 1.5'

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
									0.2'	ASPHALT PAVEMENT
	1D	24"	12"	2.2'	7	7	6	8	0.8'	BROWN SILTY SAND, SOME GRAVEL (FILL)
									3.5'	~ MEDIUM DENSE ~ BROWN SILTY SAND
										BROWN SILTY CLAY
	2D	24"	24"	7.0'	3	4	4	4		~MEDIUM STIFF~
									10.0'	BOTTOM OF EXPLORATION @ 10.0 FEET

SAMPLES: D = SPLIT SPOON  
 C = 3" SHELBY TUBE  
 U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:  DRILLER - VISUALLY  
 SOIL TECH. - VISUALLY  
 LABORATORY TEST

REMARKS: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

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BORING NO.: **B-122**

**SOIL PROFILE / CLASSIFICATION INFORMATION** **DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT PROJECT SITES**

Project Name: Proposed Elementary School      Applicant Name: City of Portland      Project Location (municipality): Portland

Exploration Symbol: TP-1g     Test Pit     Boring  
 1" Organic horizon thickness    Ground surface elev.

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0			dark brown 10YR 3/3	
6	silt loam	friable		none observed
12			dk. yel. brn. 10YR 4/6	
18			lt. olive brown 2.5Y 5/4	mfd 2.5Y 4/4 olive brown mfd 2.5Y 5/6
24				
30	silty clay loam	firm	gray 5Y 5/1	mmp olive 5Y 5/6
44			Bedrock @ 44"	
			* Seep @ 44"	

soil data by S.E. ▶▶	Soil Profile: 9	Classification: D	Slope: 0-3 Percent	Limiting Factor: 14" Depth	<input checked="" type="checkbox"/> Groundwater <input checked="" type="checkbox"/> Restrictive Layer <input type="checkbox"/> Bedrock
soil data by S.S. ▶▶	Soil series/phase name: Lamoine, deep		<input type="checkbox"/> Hydric <input checked="" type="checkbox"/> Non-hydric	Hydrologic: D	Soil Group

Exploration Symbol: TP-2g     Test Pit     Boring  
 1" Organic horizon thickness    Ground surface elev.

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0			dark brown 10YR 3/3	
6	loam	friable		none observed
12				
18	silt loam		lt. olive brn. 2.5Y 5/4	mfd 2.5Y 4/4 mfd 2.5Y 5/6
24			gray 5Y 5/1	mmp olive 5Y 5/6
33				
48	silt loam	firm	olive 5Y 4/3	mfp dk. yel. brn. 10YR 4/6
96	silt loam with layers of loamy very fine sand	firm	olive gray 5Y 4/2	mfp dk. yel. brn.
			Limit of Observation 8'	
			* Seep @ 48"	

soil data by S.E. ▶▶	Soil Profile: 8	Classification: D	Slope: 0-3 Percent	Limiting Factor: 10" Depth	<input checked="" type="checkbox"/> Groundwater <input checked="" type="checkbox"/> Restrictive Layer <input type="checkbox"/> Bedrock
soil data by S.S. ▶▶	Soil series/phase name: Lamoine variant		<input type="checkbox"/> Hydric <input checked="" type="checkbox"/> Non-hydric	Hydrologic: D	Soil Group

Exploration Symbol: TP-3g     Test Pit     Boring  
 2" Organic horizon thickness    Ground surface elev.

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0	sand		olive brown	
6		friable		none observed
12	loam w/ brick pieces		dark gray 10YR 4/1	
18	silty clay loam	firm	dark gray 5Y 4/1	mfp olive 5Y 5/6
28				
48	silt loam	very firm	gray 5Y 5/1	mfp yellowish brown 10YR 5/6
84	silt loam/loamy very fine sand layers	firm	olive gray 5Y 4/2	mfp l brndk ye
96	silty clay	firm	dk. greenish gr. 5GY 4/1	none observed
			Limit of Observation 8'	
			* Seep @ 53"	

soil data by S.E. ▶▶	Soil Profile: 8	Classification: D	Slope: 0-3 Percent	Limiting Factor: 14" Depth	<input checked="" type="checkbox"/> Groundwater <input checked="" type="checkbox"/> Restrictive Layer <input type="checkbox"/> Bedrock
soil data by S.S. ▶▶	Soil series/phase name: Lamoine variant		<input type="checkbox"/> Hydric <input checked="" type="checkbox"/> Non-hydric	Hydrologic: D	Soil Group

Exploration Symbol: TP-4g     Test Pit     Boring  
 Organic horizon thickness    Ground surface elev.

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0			very dark gray 10YR 3/1	
6		friable		none observed
12	silt loam			
18			olive brown 2.5Y 4/4	mfd lt. olive brn 2.5Y 5/6
28		firm	olive 5Y 4/4	mmd 5Y 5/6 lt. olive brn.
84	silt loam/loamy very fine sand layers	firm	dark gray 5Y 4/1	mmp yellowish brown 10YR 5/6
			Limit of Observation 7'	
			* Seep @ 18"	

soil data by S.E. ▶▶	Soil Profile: 9	Classification: D	Slope: 0-3 Percent	Limiting Factor: 10" Depth	<input checked="" type="checkbox"/> Groundwater <input checked="" type="checkbox"/> Restrictive Layer <input type="checkbox"/> Bedrock
soil data by S.S. ▶▶	Soil series/phase name: Roundabout		<input type="checkbox"/> Hydric <input checked="" type="checkbox"/> Non-hydric	Hydrologic: C	Soil Group

**INVESTIGATOR INFORMATION AND SIGNATURE**

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name Printed/typed: \_\_\_\_\_ Cert/Lic/Reg. #  

Title:     Licensed Site Evaluator     Certified Soil Scientist  
 Certified Geologist     Other:

*affix professional seal*

DEP Form F Rev. 9/01

### SOIL PROFILE / CLASSIFICATION INFORMATION

### DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT PROJECT SITES

Project Name:  
Proposed Elementary School

Applicant Name:  
City of Portland

Project Location (municipality):  
Portland

Exploration Symbol: TP-5g  Test Pit  Boring

3" Organic horizon thickness Ground surface elev.

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0				
6		friable	olive brown 2.5Y 5/4	mfd olive 5Y 5/6
12	silt loam			
18			olive 5Y 5/3	mfp yellowish brown 10YR 5/6
24		firm		
28			olive brown 2.5Y 4/4	none observed
34	loamy fine sand	friable		
40				
46	silt loam/ loamy very fine sand layers	firm	pale olive 5Y 6/3	mmp dk. yel. brn.
52				
58				
64				
70				
76				
82				
88				
94				
100				
106				
112				
118				
124				
130				
136				
142				
148				
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202				
208				
214				
220				
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988				
994				
1000				

soil data by S.E. >>	Soil Profile	Classification Condition	Slope Percent	Limiting Factor Depth	<input checked="" type="checkbox"/> Groundwater <input checked="" type="checkbox"/> Restrictive Layer <input type="checkbox"/> Bedrock
soil data by S.S. >>	Soil series/phase name: Roundabout		<input checked="" type="checkbox"/> Hydric <input type="checkbox"/> Non-hydric	Hydrologic Soil Group C	

Exploration Symbol: TP-6g  Test Pit  Boring

3" Organic horizon thickness Ground surface elev.

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0				
6		friable	very dark gray 10YR 3/1	none observed
12	silt loam			
18		firm	olive 5Y 5/4	mfd olive 5Y 5/6
24				
28				
32	silty clay loam	very firm	dark gray 5Y 4/1	mmp yellowish brown 10YR 5/6
38				
42	silt loam/ loamy very fine sand layers	firm	pale olive 5Y 6/3	mmp dk. yel. brn. 10YR 4/6
48				
54				
60				
66				
72				
78				
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				
144				
150				
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972				
978				
984				
990				
996				
1000				

soil data by S.E. >>	Soil Profile	Classification Condition	Slope Percent	Limiting Factor Depth	<input checked="" type="checkbox"/> Groundwater <input checked="" type="checkbox"/> Restrictive Layer <input type="checkbox"/> Bedrock
soil data by S.S. >>	Soil series/phase name: Roundabout		<input type="checkbox"/> Hydric <input checked="" type="checkbox"/> Non-hydric	Hydrologic Soil Group C	

Exploration Symbol: TP-7g  Test Pit  Boring

1" Organic horizon thickness Ground surface elev.

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0				
6				
12	stony fine sandy loam (fill)	friable	brown 10YR 5/3	none observed
18				
24				
30				
36	silt loam	friable	lt. olive brown 2.5Y 5/4	mmp dk. yel. brn.
42	silt clay loam	very firm	olive gray 5Y 5/2	mcp dk. yel. brn.
48				
54	silt loam/ loamy very fine sand layers	firm	olive gray 5Y 4/2	mcp dk. yel. brn.
60				
66				
72				
78				
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				
144				
150				
156				
162				
168				
174				



**KEY TO THE NOTES & SYMBOLS**  
**Test Boring and Test Pit Explorations**

All stratification lines represent the approximate boundary between soil types and the transition may be gradual.

**Key to Symbols Used:**

- w - water content, percent (dry weight basis)
- q<sub>u</sub> - unconfined compressive strength, kips/sq. ft. - based on laboratory unconfined compressive test
- S<sub>v</sub> - field vane shear strength, kips/sq. ft.
- L<sub>v</sub> - lab vane shear strength, kips/sq. ft.
- q<sub>p</sub> - unconfined compressive strength, kips/sq. ft. based on pocket penetrometer test
- O - organic content, percent (dry weight basis)
- W<sub>L</sub> - liquid limit - Atterberg test
- W<sub>P</sub> - plastic limit - Atterberg test
- WOH - advance by weight of hammer
- WOM - advance by weight of man
- WOR - advance by weight of rods
- HYD - advance by force of hydraulic piston on drill
- RQD - Rock Quality Designator - an index of the quality of a rock mass. RQD is computed from recovered core samples.
- γ<sub>T</sub> - total soil weight
- γ<sub>B</sub> - buoyant soil weight
- f - fines content (percent by weight passing U.S. No. 200 Sieve)

**Description of Proportions:**

- 0 to 5% TRACE
- 5 to 12% SOME
- 12 to 35% "Y"
- 35+% AND

**REFUSAL: Test Boring Explorations** - Refusal depth indicates that depth at which, in the drill foreman's opinion, sufficient resistance to the advance of the casing, auger, probe rod or sampler was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

**REFUSAL: Test Pit Explorations** - Refusal depth indicates that depth at which sufficient resistance to the advance of the backhoe bucket was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

Although refusal may indicate the encountering of the bedrock surface, it may indicate the striking of large cobbles, boulders, very dense or cemented soil, or other buried natural or man-made objects or it may indicate the encountering of a harder zone after penetrating a considerable depth through a weathered or disintegrated zone of the bedrock.



**KEY TO THE NOTES & SYMBOLS**  
**Soil Profile Test Pit Explorations**

All stratification lines represent the approximate boundary between soil types and the transition may be gradual.

**Key to Symbols Used:**

**TEXTURES**

s	-	sand	sci	-	sandy clay loam
ls	-	loamy sand	sc	-	sandy clay
sl	-	sandy loam	cl	-	clay loam
l	-	loam	sicl	-	silty clay loam
sil	-	silt loam	sic	-	silty clay
si	-	silt	c	-	clay

**CONSISTENCY**

loose  
very friable  
friable  
firm  
very firm  
ext. firm  
cemented

**MOTTLES**

**Number**

few (f) <2%  
common (c) 2 – 20%  
many (m) >20%

**Size**

fine (f) <0.2"  
medium (m) 0.2" – 0.6"  
coarse (c) >0.6"

**Contrast**

faint (f)  
distinct  
prominent

Example: Many, medium size, distinct mottles would be designated as: mmd

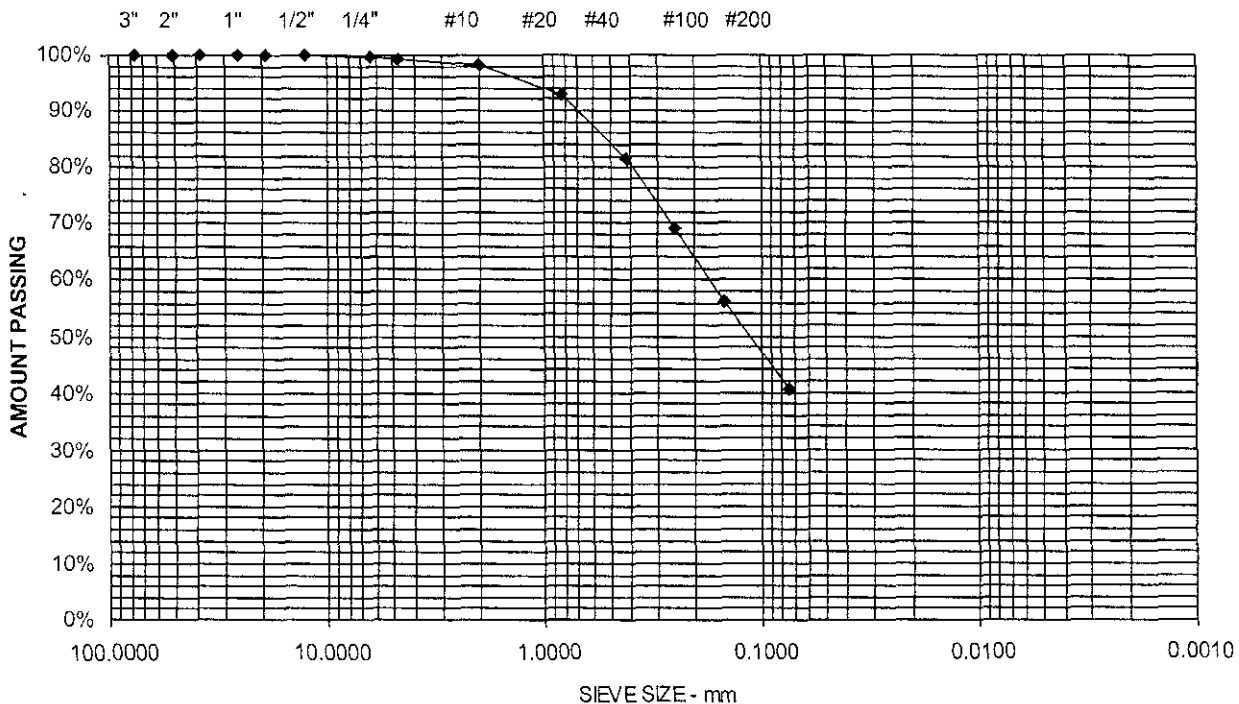
Although refusal may indicate the encountering of the bedrock surface, it may indicate the striking of large cobbles, boulders, very dense or cemented soil, or other buried natural or man-made objects or it may indicate the encountering of a harder zone after penetrating a considerable depth through a weathered or disintegrated zone of the bedrock.

Project Name PORTLAND - PROPOSED ELEMENTARY SCHOOL - DESIGN  
PHASE - GEOTECHNICAL ENGINEERING SERVICES  
Client CITY OF PORTLAND  
Exploration 0-2  
Material Source B-101 1D

Project Number 07-0234.1  
Lab ID 8481G  
Date Received 5/22/2008  
Date Complete 5/27/2008  
Tested By JUSTIN BISSON

<u>STANDARD DESIGNATION (mm/μm)</u>	<u>SIEVE SIZE</u>	<u>AMOUNT PASSING (%)</u>	
150 mm	6"	100	
125 mm	5"	100	
100 mm	4"	100	
75 mm	3"	100	
50 mm	2"	100	
38.1 mm	1-1/2"	100	
25.0 mm	1"	100	
19.0 mm	3/4"	100	
12.5 mm	1/2"	100	
6.3 mm	1/4"	100	
4.75 mm	No. 4	99	0.5% Gravel
2.00 mm	No. 10	98	
850 μm	No. 20	93	
425 μm	No. 40	82	59% Sand
250 μm	No. 60	69	
150 μm	No. 100	56	
75 μm	No. 200	40.4	40.4% Fines

**SILT AND SAND, TRACE GRAVEL**

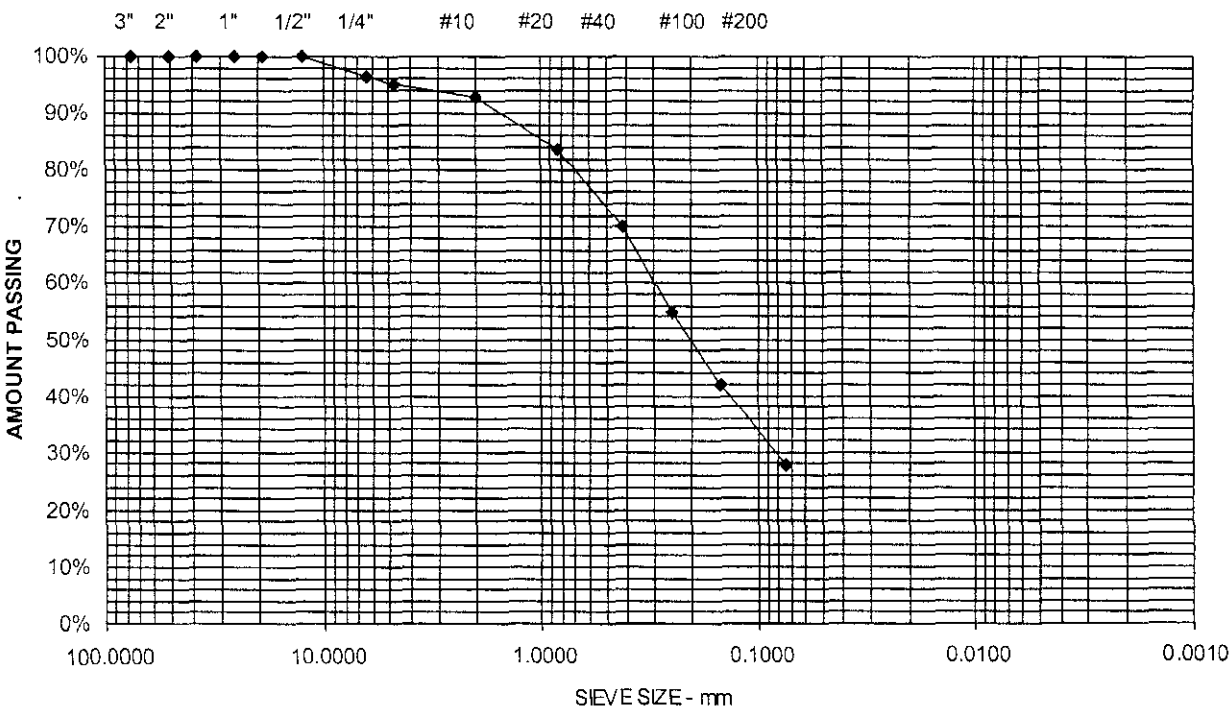


Project Name PORTLAND - PROPOSED ELEMENTARY SCHOOL - DESIGN  
PHASE - GEOTECHNICAL ENGINEERING SERVICES  
Client CITY OF PORTLAND  
Exploration 0-2  
Material Source B-102 1D

Project Number 07-0234.1  
Lab ID 8482G  
Date Received 5/22/2008  
Date Complete 5/27/2008  
Tested By CRAIG TURCOTTE

<u>STANDARD DESIGNATION (mm/um)</u>	<u>SIEVE SIZE</u>	<u>AMOUNT PASSING (%)</u>	
150 mm	6"	100	
125 mm	5"	100	
100 mm	4"	100	
75 mm	3"	100	
50 mm	2"	100	
38.1 mm	1-1/2"	100	
25.0 mm	1"	100	
19.0 mm	3/4"	100	
12.5 mm	1/2"	100	
6.3 mm	1/4"	96	
4.75 mm	No. 4	95	5% Gravel
2.00 mm	No. 10	93	
850 um	No. 20	84	
425 um	No. 40	70	67.2% Sand
250 um	No. 60	55	
150 um	No. 100	42	
75 um	No. 200	27.8	27.8% Fines

**SILTY SAND, TRACE GRAVEL**

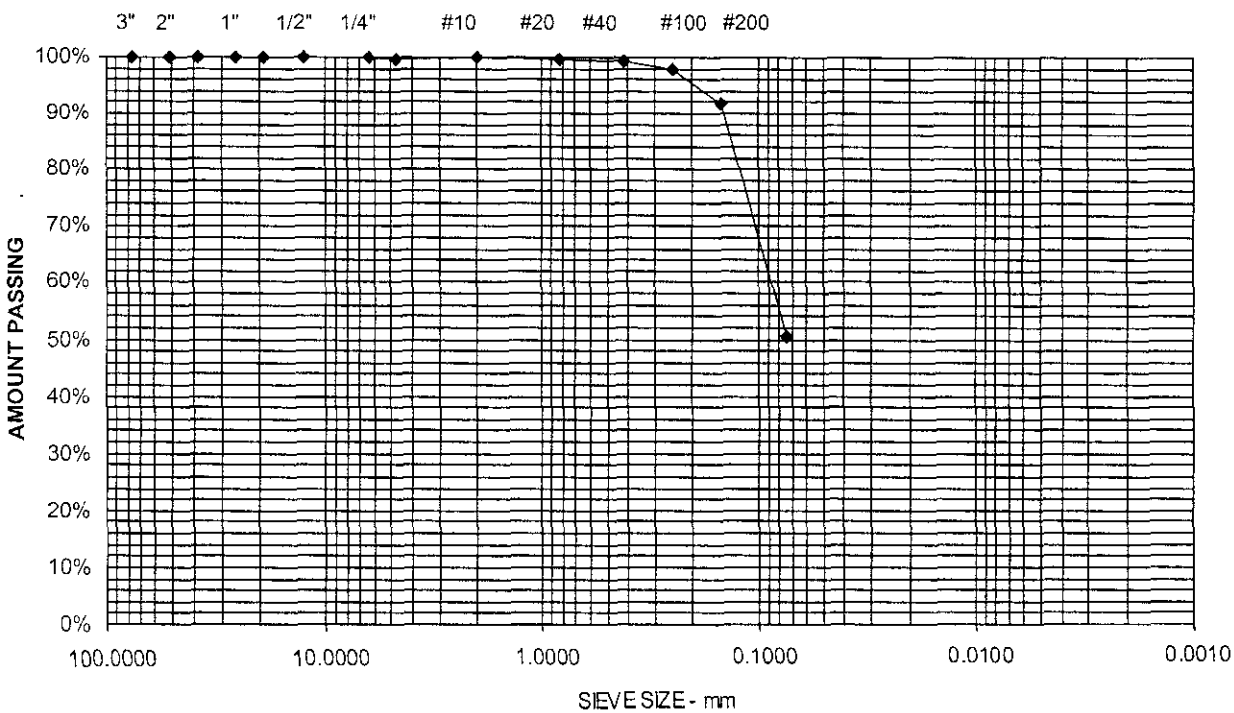


Project Name PORTLAND - PROPOSED ELEMENTARY SCHOOL - DESIGN  
PHASE - GEOTECHNICAL ENGINEERING SERVICES  
Client CITY OF PORTLAND  
Exploration 5-7  
Material Source B-105 2D

Project Number 07-0234.1  
Lab ID 8483G  
Date Received 5/22/2008  
Date Complete 5/27/2008  
Tested By CRAIG TURCOTTE

<u>STANDARD DESIGNATION (mm/um)</u>	<u>SIEVE SIZE</u>	<u>AMOUNT PASSING (%)</u>	
150 mm	6"	100	
125 mm	5"	100	
100 mm	4"	100	
75 mm	3"	100	
50 mm	2"	100	
38.1 mm	1-1/2"	100	
25.0 mm	1"	100	
19.0 mm	3/4"	100	
12.5 mm	1/2"	100	
6.3 mm	1/4"	100	
4.75 mm	No. 4	100	0.2% Gravel
2.00 mm	No. 10	100	
850 um	No. 20	100	
425 um	No. 40	99	49.1% Sand
250 um	No. 60	98	
150 um	No. 100	92	
75 um	No. 200	50.7	50.7% Fines

**SILT AND SAND, TRACE GRAVEL**



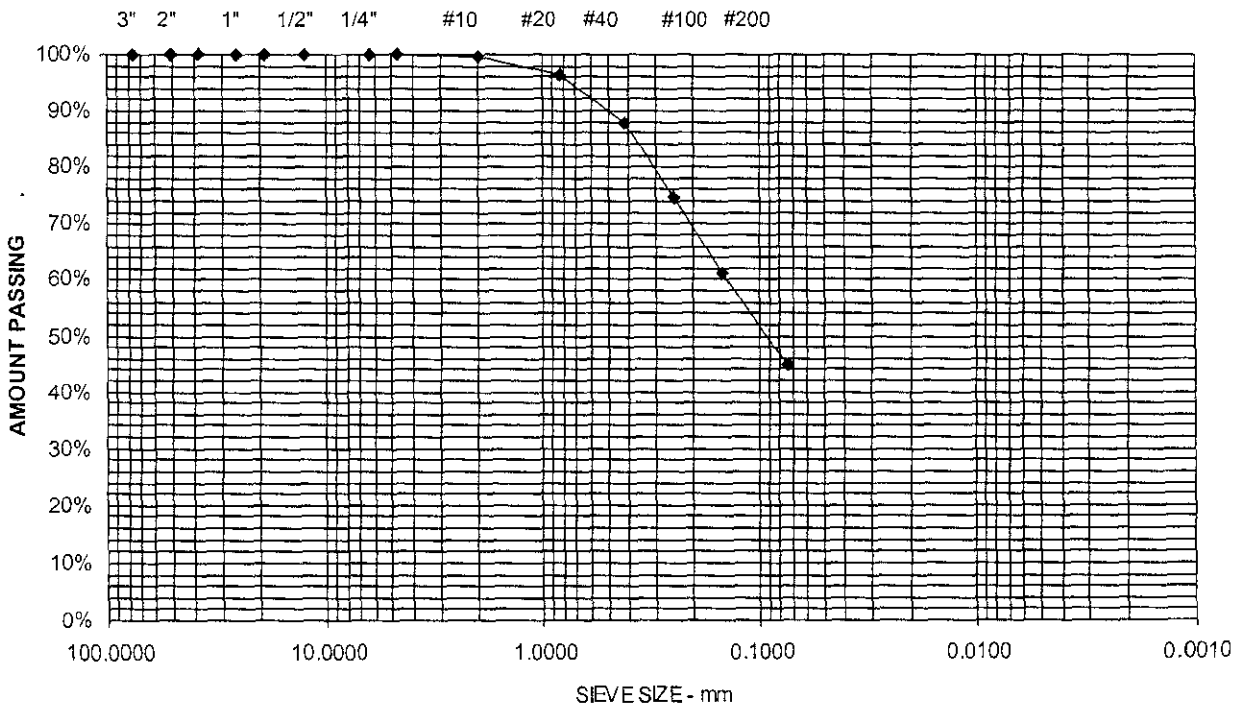


Project Name PORTLAND - PROPOSED ELEMENTARY SCHOOL - DESIGN  
PHASE - GEOTECHNICAL ENGINEERING SERVICES  
Client CITY OF PORTLAND  
Exploration 2-4  
Material Source B-119 1D

Project Number 07-0234.1  
Lab ID 8484G  
Date Received 5/22/2008  
Date Complete 5/27/2008  
Tested By JUSTIN BISSON

<u>STANDARD</u> <u>DESIGNATION (mm/um)</u>	<u>SIEVE SIZE</u>	<u>AMOUNT PASSING (%)</u>	
150 mm	6"	100	
125 mm	5"	100	
100 mm	4"	100	
75 mm	3"	100	
50 mm	2"	100	
38.1 mm	1-1/2"	100	
25.0 mm	1"	100	
19.0 mm	3/4"	100	
12.5 mm	1/2"	100	
6.3 mm	1/4"	100	
4.75 mm	No. 4	100	0% Gravel
2.00 mm	No. 10	100	
850 um	No. 20	96	
425 um	No. 40	88	55.3% Sand
250 um	No. 60	75	
150 um	No. 100	61	
75 um	No. 200	44.7	44.7% Fines

### SILT AND SAND

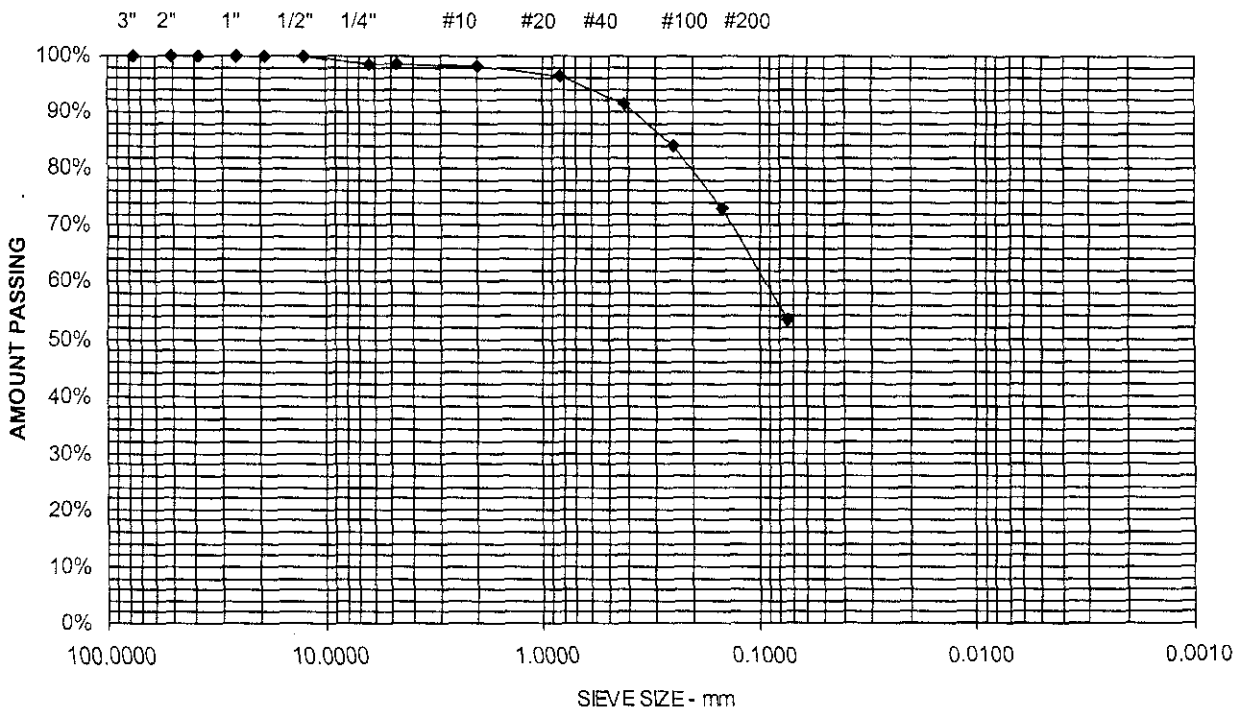


Project Name PORTLAND - PROPOSED ELEMENTARY SCHOOL - DESIGN  
PHASE - GEOTECHNICAL ENGINEERING SERVICES  
Client CITY OF PORTLAND  
Exploration 5-6.7  
Material Source B-120 2D

Project Number 07-0234.1  
Lab ID 8485G  
Date Received 5/22/2008  
Date Complete 5/27/2008  
Tested By JUSTIN BISSON

<u>STANDARD DESIGNATION (mm/um)</u>	<u>SIEVE SIZE</u>	<u>AMOUNT PASSING (%)</u>	
150 mm	6"	100	
125 mm	5"	100	
100 mm	4"	100	
75 mm	3"	100	
50 mm	2"	100	
38.1 mm	1-1/2"	100	
25.0 mm	1"	100	
19.0 mm	3/4"	100	
12.5 mm	1/2"	100	
6.3 mm	1/4"	99	
4.75 mm	No. 4	99	1.4% Gravel
2.00 mm	No. 10	98	
850 um	No. 20	97	
425 um	No. 40	92	45.2% Sand
250 um	No. 60	84	
150 um	No. 100	73	
75 um	No. 200	53.4	53.4% Fines

**SILT AND SAND, TRACE GRAVEL**



Project Name PORTLAND - PROPOSED ELEMENTARY SCHOOL - DESIGN  
 PHASE - GEOTECHNICAL ENGINEERING SERVICES  
 Client CITY OF PORTLAND  
 Exploration 0.2-2.2  
 Material Source B-122 1D

Project Number 07-0234.1  
 Lab ID 8486G  
 Date Received 5/22/2008  
 Date Complete 5/27/2008  
 Tested By JUSTIN BISSON

<u>STANDARD DESIGNATION (mm/μm)</u>	<u>SIEVE SIZE</u>	<u>AMOUNT PASSING (%)</u>	
150 mm	6"	100	
125 mm	5"	100	
100 mm	4"	100	
75 mm	3"	100	
50 mm	2"	100	
38.1 mm	1-1/2"	100	
25.0 mm	1"	100	
19.0 mm	3/4"	100	
12.5 mm	1/2"	88	
6.3 mm	1/4"	82	
4.75 mm	No. 4	80	19.9% Gravel
2.00 mm	No. 10	74	
850 μm	No. 20	53	
425 μm	No. 40	33	71.6% Sand
250 μm	No. 60	22	
150 μm	No. 100	15	
75 μm	No. 200	8.5	8.5% Fines

**GRAVELLY SAND, TRACE SILT**

