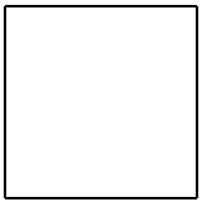
PROJECT MANUAL

OLDS STATION CAMPUS
Chelan County

Wenatchee, Washington



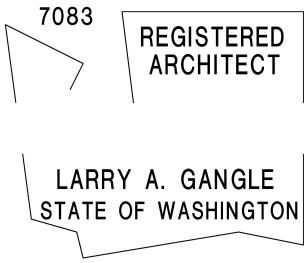
DOH #2344

ARCHITECTS & PLANNERS · The DOH Associates, PS · WENATCHEE, WASHINGTON

Chelan County
OLDS STATION CAMPUS
Wenatchee, Washington

DOH #2344

January 6, 2025



CHELAN COUNTY:

Board of County Commissioners:

District 1	Mr. Kevin Overbay
District 2	Mr. Shon Smith
District 3	Mr. Brad Hawkins

Economic Services Director:

Mr. Ron Cridlebaugh

ARCHITECT:

THE DOH ASSOCIATES, PS
7 N. Wenatchee Avenue, Suite 500
Wenatchee, Washington 98801
phone: 509-662-4781

DIVISION 26 – ELECTRICAL

DIVISION 27 – COMMUNICATIONS

DIVISION 28 – ELECTRICAL SAFETY AND SECURITY

DIVISION 31 – EARTHWORK

DIVISION 32 – EXTERIOR IMPROVEMENTS

END OF SECTION – TABLE OF CONTENTS

SECTION 00 11 16 – INVITATION TO BID.

PART 1 – GENERAL

1.1 NOTICE TO CONTRACTORS

A. Sealed bids will be received by Chelan County at Board of County Commissioner's Office, 400 Douglas Street, Suite 201, Wenatchee, Washington for the construction of the Olds Station Campus in Wenatchee, Washington.

B. Time limits for receipt of proposals are as follows:

1. Section 00 41 00 – Price Proposal must be received by 10:30 am (local time) on Monday, February 10, 2025.

2. Section 00 41 10 – Subcontractor's Listing A must be received not later than one hour after the Price Proposal time limit.

3. Section 00 41 20 – Subcontractor's Listing B must be received not later than one hour after the Price Proposal time limit.

4. Bids received after this time will not be considered.

1.2 SCOPE OF WORK

A. Construction of (3) poles buildings, single and 2-story, sized approximately 5,600 sf, 6,600 square feet, and 1,848, a new 7,905 sf wood framed, partial 2 story building. The project includes a new asphalt drive and parking; landscape and irrigation; utility extensions, concrete walks, footings and slabs; trench drains and oil water separators; casework; fiberglass and rigid insulation; metal siding, roofing, flashing, gutters, and downspouts; hollow frames, hollow metal doors, wood doors, aluminum windows, and overhead doors; interior metal stud and drywall walls and ceilings; suspended acoustical ceilings, resilient, carpet, and resinous flooring finishes, and paint; toilet room specialties and signage; window shades; walk-in cooler; HVAC systems; electrical systems, power, communications wiring, alarm systems, lighting, automated vehicle gates, chain link fencing, etc.

1.3 CONTRACT DOCUMENTS

A. Bidding Documents, including Instructions to Bidders, Form of Agreement, General Requirements, Drawings and Specifications entitled, "Olds Station Campus" may be requested from the Architect in Portable Document Format (PDF) and may also be examined at various construction councils and builder association plan centers, a list of which is available from the office of the Architect.

1. Architect: The DOH Associates, PS, 7 N. Wenatchee Avenue, Suite 500, Wenatchee, WA 98801, (509) 662-4781

2. Drawings and Specifications are also available on the Chelan County website: https://www.co.chelan.wa.us/board-of-commissioners

B. Prime bidders, other sub-bidders and suppliers may purchase sets or parts of sets by paying for the cost of reproduction.

C. Bidders who are bidding without procuring plans from the Architect, are encouraged to provide contact information to the Architect for inclusion in the bidder's list and electronic notifications.

1.4 PREVAILING WAGE

A. The State of Washington prevailing wage rates are applicable for this public works project located in Chelan County. Bidders are responsible to verify and use the most recent prevailing wage rates. The "Effective Date" for this project is the Bid Proposal due date above. The applicable prevailing wage rates may be found on the Department of Labor and Industries website located at:

1. https://secure.lni.wa.gov/wage lookup/

B. Apprenticeship Utilization Requirements - In accordance with RCW 39.04.320, where the cost of the project is $1,000,000 or more the Contractor shall have no less than 15% of the labor hours performed by apprentices. Reference the Contract for additional information.

C. Upon request, the Owner will mail a hard copy of the applicable prevailing wages for this project. Please contact the DOH Associates at (509) 662-4781.

1.5 TITLE VI STATEMENT

A. Chelan County, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 U.S.C. 2000d to 2000d-4) and Title 49 CFR, Subtitle A, Part 21 Nondiscrimination in Federally-Assisted Programs of the Department of Transportation), hereby notifies all bidders that it will affirmatively ensure that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award.

1.6 BID OPENING

A. Bids will be opened and read publicly (aloud) by the Owner's representative immediately following the hour set above.

B. The Owner reserves the right to reject any and all bids and to waive irregularities or informalities, without cause.

1. By Order of: Chelan County Board of Commissioners

1.7 PUBLICATIONS

A. Published as legal advertisement:

1. Wenatchee World — January 16 and January 23, 2025
2. Daily Journal of Commerce — January 16 and January 23, 2025

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION 00 11 16

SECTION 00 21 00 – INSTRUCTIONS TO BIDDERS

PROPOSALS, to be entitled to consideration, must be made in accordance with the following instructions:

PART 1 – GENERAL

1.1 EXAMINATION OF DOCUMENTS

A. Before submitting a proposal, a bidder shall:

1. Carefully examine the Drawings and Specifications.

2. Visit the site of the Work, making such observations and measurements as may be required.

3. Fully inform himself of existing conditions and limitations.

4. Rely entirely upon his own judgment in preparing his proposal.

5. Include in his bid a sum sufficient to cover all items required by the Contract.

B. Failure to do any of the above shall not relieve the bidder from entering into Contract nor excuse him from performing the Work in strict accordance with the terms of the Contract Documents.

C. Except as specifically provided for hereinafter, a Bidder will not be entitled to additional compensation if he subsequently finds the existing conditions to require methods or equipment that he did not anticipate in arriving at his bid sum(s).

1.2 INTERPRETATIONS

A. Questions regarding Drawings and Specifications should be addressed to the Architect and will be answered by addenda addressed to all bidders.

B. Bidders finding discrepancies, omissions or points of doubtful meaning in the Documents should notify the Architect immediately, and if at all possible at least 36 hours before time set for bid opening.

C. Neither Owner nor Architect will be responsible for oral questions or interpretations. No statement regarding the Work, except as made by bidding documents or addenda thereto, shall be binding upon the Owner.

D. Questions received less than 4 days (96 hours) before time set for bid opening will not be answered.

E. All addenda issued during the bidding period will be incorporated into the Contract. Each bidder must acknowledge each addendum issued, in the space provided therefore on the bid form, in order to have his bid considered.

1.3 FORM OF PROPOSAL

A. Proposals shall be made upon forms provided for that purpose, signed in longhand by the bidder and with his company name and position typed in the spaces provided. If a bidder is a partnership or co-partnership, at least one partner must sign; if a corporation, print name of corporation, State in which incorporated, and follow by signatures of persons authorized to sign, naming the offices they hold in the corporation.

B. Each proposal shall specify a unit or lump sum price, typed or written with ink in both words and figures, for each of the separate items as called for. In case of discrepancy between the written words and figures, the written words shall govern. Any omission of prices for items, including unit costs, shown in the form of proposal or any addition in writing to the form, or any added conditions, limitations or provisions, will be liable to render the proposal informal and cause its rejection.

C. Fill all blank spaces in the bid form whether with a bid figure or with "Not Applicable" or "No Bid".

1.4 SUBSITUTIONS – PRIOR APPROVAL

A. Bids shall be based strictly upon items and materials either specified in the Contract Documents or which have received **written prior approval** as stipulated in DIVISION 1 of the Specifications. By signing the Agreement, the Contractor shall warrant that he has verified availability and delivery in order to properly complete the Work within the stipulated time of completion, and agrees that these are the items and materials to be utilized in the Work.

B. Where a manufacturer and model or type number is specified and other manufacturers are named in connection therewith, such additional named manufacturers may submit quotations on their equivalent products, subject to conformance with the provisions of the Contract Documents, without approval prior to bid opening.

C. Substitutions, other than of manufacturers so named, may be made **ONLY** under the conditions and procedures described in DIVISION 1 of the specifications.

1.5 DELIVERY OF PROPOSAL

A. Bid Proposal and Bid Guarantee shall be enclosed in an opaque sealed envelope, addressed and marked as follows so as to guard against premature opening of any bid:

1. (Name of Bidder Here)

Chelan County
Board of County Commissioners
400 Douglas Street, Suite 201
Wenatchee, WA 98801

PROPOSAL FOR: OLDS STATION CAMPUS

B. Bids shall be delivered to the Owner's representative appointed to receive bids, as required by the Invitation to Bid.

1.6 MODIFICATION OR WITHDRAWL OF PROPOSALS AFTER DELIVERY

A. A bidder may, without prejudice to himself, withdraw, modify, or correct a proposal after it has been deposited with the Owner, provided the request for such withdrawal, modification or correction is filed with the Owner in writing, hand delivered, or by e-mail to larry@doharchitects.com and ron.cridlebaugh@co.chelan.wa.us received before the time set for opening proposals. The original proposal, as modified by such written or electronic communication, will be considered as the proposal submitted by the bidder. Modifications will be accepted only if such modification is received prior to the bid opening time and same is confirmed in writing on the official letterhead of the Contractor.

B. Modification(s) of amounts should only state the amount to be added to, or subtracted from, the original submitted proposal so that the final bid will not be revealed until the sealed proposal is opened.

C. Oral or telephone modifications or withdrawals of bids cannot be considered.

D. No bidder will be permitted to withdraw his proposal between the closing time for receipt of proposals and the actual award of Contract, unless the award is delayed for a period exceeding 30 calendar days.

1.7 OPENING OF BIDS

A. Bids received prior to the time of opening will be securely kept, unopened. The Owner's representative, whose duty it is to open them, will determine when the specified time has arrived, and no bid received thereafter will be considered. No responsibility will be attached to the Owner for the premature opening of an improperly addressed or identified bid.

B. At the time and place fixed for the opening of bids, every bid received within the time fixed for receiving bids will be opened and read (publicly), irrespective of irregularities therein, and a tabulation of bids will be furnished to all prime bidders as soon as possible thereafter.

1.8 BID GUARANTEE

A. As a guarantee that if awarded the Contract, the bidder will execute same, each bid shall be accompanied by a certified or bank cashier's check or by a Bid Bond, in the amount not less than five percent (5%) of the total Bid (including alternates, if any) made payable to Chelan County. Bid Bonds must be furnished by a company licensed to do business as surety in the State of Washington.

B. The successful bidder's bid guarantee will be retained until he has entered into Contract and furnished satisfactory Performance Bond and Certificates of Insurance. The Owner reserves the right to hold the bid guarantees of the 2 next lowest bidders until he has done so, or for a period of 30 days, whichever is the shorter time. Bid guarantees of all other bidders will be returned as soon as practicable after bids are opened.

C. Should a bidder fail to enter into Contract and furnish bond and insurance certification, within 10 days after notice that his proposal has been accepted, his bid guarantee and the proceeds thereof shall be retained by the Owner as liquidated damages, not as penalty.

1.9 EVALUATION OF PROPOSALS – EVIDENCE OF QUALIFICATIONS

A. All proposals will be evaluated in accordance with criteria set forth in Washington State Law, the Requirements of the Contract, and the best interests of the Owner.

B. Numbering of Alternates does not imply the order in which Alternate Bids may be accepted. The Owner reserves the right to accept, or reject, any Alternate Bid in order to produce whichever combination of Base Bid and Alternates he determines will provide the best value for the Project as a whole. Determination of low bid shall be based upon the aggregate total(s) of Base Bid plus selected Alternate Bids, if any.

C. A bidder whose proposal is under consideration shall, upon request, promptly furnish satisfactory evidence of his financial resources, sub-bidders used in his proposal, his experience, and the organization and equipment he has available for the performance of the Contract.

D. Prior to award and in accordance with RCW 39.04.350, the bidder shall submit a signed sworn statement verifying compliance with the responsible bidder criteria listed in the statute.

E. The Owner reserves the right to reject any or all proposals without cause, waive technicalities, if such waiver is in the best interest of the Owner and is in conformance with State and local laws or regulations pertaining to the letting of construction contracts; advertise for new proposals; or proceed with the work.

F. Without limiting the generality of the foregoing, the Owner may reject any proposal for any of the following reasons:

1. If the proposal is on a form other than that furnished by the Owner, or if the Owner's form is altered, or if any part of the proposal form is detached.

2. If there are unauthorized additions, conditional or alternate pay items or irregularities of any kind which make the proposal incomplete, indefinite or otherwise ambiguous.

3. If for any reason the Owner determines the proposal to be non-responsive or obscure.

4. If the proposal does not contain a unit price for each pay item or a price for each alternate.

5. If the proposal contains unit prices that are obviously unbalanced.

6. If the proposal is not accompanied by a proposal guarantee (Bid Bond) or is accompanied by an insufficient or irregular proposal guarantee.

7. Any proposal from a Bidder which has previously failed to perform satisfactorily, or to complete on time, construction of any nature.

1.10 AWARD OF THE CONTRACT

A. Chelan County will, within thirty (30) days of Bid opening, either reject all bids or proceed to award the Contract for the above Work to the lowest qualified bidder with adequate security.

1. A Contract will not be awarded until Chelan County is satisfied that the successful bidder is reasonably familiar with the class of work contemplated and has the necessary capital, tools and experience to satisfactorily perform the work within the time stated. Completion of the work within the time stated is essential and prior commitments of the bidder, failure to complete other work on time, or reasonable doubt as to whether the bidder would procure equipment or complete the project on time would be cause for rejection of any bid. In addition, the Owner may determine any bidder not to be responsible in accordance with RCW 43.13.1911(9) and/or any other legal authority.

B. The acceptance of the Bid shall be a notice in writing titled "Notice of Award" signed by a duly authorized representative of Chelan County, and no other act shall constitute acceptance of the Bid.

C. Formal execution of the Agreement shall be consummated within 10 days of Notice of Award. Time for completion of the Contract shall commence at 12:00 noon on date of Agreement execution.

D. Within seven (7) days of the Notice of Award of Bid, and prior to execution of Agreement, successful bidder shall submit to the Architect for review:

1. Performance and Payment Bonds in the full amount of the Contract Sum, plus Washington State Sales Tax.

2. Certificate(s) of Insurance as stipulated in the General Conditions and Supplementary Conditions.

3. Complete list of subcontractors and major materials suppliers to be utilized on the Work.

1.11 FORM OF AGREEMENT

A. The Form of Agreement shall be the AIA "Standard Abbreviated Form of Agreement Between Owner and Contractor" (A104-2017), edited to include additional conditions of the Contract.

1.12 OWNER'S PROTECTIVE BOND(S) and INSURANCE

A. The successful bidder shall furnish to the Owner a corporate surety bond in the full amount of the Contract Sum, **plus Washington State Sales Tax,** conditioned for the faithful performance of the Contract and for the payment of all laborers, mechanics,

subcontractors, materialmen, and all persons who shall supply such person or persons, or subcontractors, with provisions and supplies for the carrying on of the work of said Contract. The surety must be authorized to do business in the State of Washington and be of form satisfactory to the Owner.

B. The successful bidder shall furnish Certificates of Insurance complying with the requirements set forth in the General Conditions and Supplementary General Conditions, and in form satisfactory to the Owner.

1.13 DATE OF COMPLETION and LIQUIDATED DAMAGES

A. The Contractor will be required to credit the Owner the amount(s) stipulated in the Supplementary General Conditions, not as a penalty but as liquidated damages, for each calendar day that the Contractor shall be in default beyond the number of days stipulated in the Form of Proposal as constituting the time for completion of the Contract.

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION 00 21 00

SECTION 00 41 00 – FORM OF PROPOSAL

PART 1 – GENERAL

1.1 TO:

A. Chelan County Board of Commissioners

1. 400 Douglas Street, Suite 201
   Wenatchee, WA 98801

1.2 FOR:

A. OLDS STATION CAMPUS

1. Dated: January 6, 2025

2. To be constructed in Wenatchee, Washington

1.3 OFFER:

A. Having carefully examined the Bidding Requirements and Contract Documents for the project, as well as the premises and conditions affecting the Work, the undersigned proposes to furnish all labor and materials and perform all Work for the various parts of the construction in accordance with the above documents for consideration of the following amounts:

1. Combined Work Base Bid

_____ Dollars

($_____).

1.4 EXTRA WORK

A. The undersigned agrees that, should any extra work be ordered, the following percentages shall be added to material and labor costs to cover overhead and profit:

1. Allowance to General Contractor for overhead and profit for extra work performed by the Contractor's own force:

   a. Fifteen percent (15%)

2. Allowance to General Contractor for overhead and profit for extra work performed by the Subcontractor:

   a. Ten percent (10%)

3. Allowance to each Subcontractor (of any tier) for overhead and profit for extra materials or work performed by the Subcontractor's own force:

a. Fifteen percent (15%)

4. Allowance to each Subcontractor (of any tier) for overhead and profit for extra materials or work performed by its Subcontractor of any lower tier:

a. Ten percent (10%)

B. The above percentages shall include **ALL** overhead and incidental costs, including insurance, fees, small tools, project management, superintendence and oversight, etc., except for performance and payment bonds, builder's risk insurance charges, direct labor and equipment rental costs and state sales tax.

1.5 SUBCONTRACTORS

A. The undersigned agrees, if awarded the Contract, to employ the subcontractors listed in Section 00 41 10, SUBCONTRACTOR LISTING A, and Section 00 41 20, SUBCONTRACTOR LISTING B for the trades indicated. The Subcontractor listing in Section 00 41 10 and 00 41 20 shall be complete and shall include all Subcontractors required to be listed by State law and all additional Subcontractors where specifically requested. The undersigned further agrees that said subcontractors may not be changed without good cause and written consent of the Owner.

1.6 OVERHEAD, PROFIT & SALES TAX

A. **ALL** of the above bid prices include overhead and profit.

B. **NONE** of the above bid prices include Washington State Sales Tax.

1.7 CONTRACT and REQUISITES

A. If the undersigned is notified of the acceptance of this bid within 30 calendar days after the time set for the opening of bids, he agrees to execute an Agreement for the above work, for the compensation computed from the above sums, on the modified AIA Form of Agreement A104-2017 included within and to furnish Performance and Payment Bonds, Certificates of Insurance and Schedules, all as required by the Specifications and Instructions to Bidders.

1.8 BID GUARANTEE

A. The undersigned further agrees that the check or bid bond accompanying this proposal is left in escrow with the Architect, and that its amount is the measure of damages which the Owner will sustain by the failure of the undersigned to execute an Agreement for the Work in the form stipulated in the Bidding Documents, and furnish the required bonds, and that if the undersigned fails to execute said Agreement and deliver said bonds within 10 days after written Notice of Award of the Contract to him has been received, then the check shall become the property of the Owner, or the bid bond shall remain in full effect; but if this bid is not accepted within 30 days after the time set for opening bids, or if the undersigned delivers said bonds and executes said Agreement, then the check shall be returned to him or the bid bond shall become void.

1.9 TIME OF COMPLETION

A. The undersigned agrees that if awarded the Contract, the Work will be substantially completed in not more than 215 calendar days from the date of signing of Agreement, and fully completed not more than 45 calendar days after Substantial Completion. The undersigned further agrees to provisions for payment of liquidated damages as stipulated in the Supplementary General Conditions.

1.10 ADDENDA

A. The undersigned hereby acknowledges receipt of the following Addenda, all costs, provisions and requirements of which Addenda have been incorporated in the foregoing proposal:

_____

(list each addendum number separately, if none received, enter "none")

1.11 BID FORM SIGNATURES

(Legal name of bidding firm)	Address
Contractor's Registration Number	City State Zip
By (Name and Title)	Phone
Signature	

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION 00 41 00

SECTION 00 41 10 – SUBCONTRACTOR LISTING A

PART 1 – GENERAL

1.1 TO:

A. Chelan County Board of Commissioners

1.2 FOR:

A. OLDS STATION CAMPUS

1.3 SUBCONTRACTOR LISTING

A. The undersigned agrees, if awarded the Contract, to employ the following sub-contractors for the trades (or types of work) listed.

B. If the total of Base Bid and all additive Alternates exceeds, is anticipated to exceed or if the owner's estimate exceeds $1,000,000, list the sub- contractor(s) responsible for the heating, ventilation and air conditioning, plumbing as described in Chapter 18.106 RCW, and electrical as described in Chapter 19.28 RCW and as required below by the owner. The bidder shall not list more than one sub-contractor for each category of work identified, unless sub-contractors vary with bid alternates, in which case the bidder must indicate which sub-contractor will be used for which alternate(s). If a category of work listed above will not be sub-contracted, the bidder must list itself. Failure to name such sub-contractors or itself shall render the bidder's bid non-responsive.

C. Name Subcontractors for the fields of work pre-listed regardless of percentage or contract value.

1. HVAC Work: _____
2. Plumbing Work: _____
3. Electrical Work: _____
4. _____
5. _____

1.4 BID FORM SIGNATURES

_____ _____

By (Name and Title) Signature

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION 00 41 10

SECTION 00 41 20 – SUBCONTRACTOR LISTING B

PART 1 – GENERAL

1.1 TO:

A. Chelan County Board of Commissioners

1.2 FOR:

A. OLDS STATION CAMPUS

1.3 SUBCONTRACTOR LISTING

A. The undersigned agrees, if awarded the Contract, to employ the following sub-contractors for the trades (or types of work) listed.

B. If the total of Base Bid and all additive Alternates exceeds, is anticipated to exceed or if the owner's estimate exceeds $1,000,000, list the sub- contractor(s) responsible for the rebar installation, and structural steel installation. The bidder shall not list more than one sub-contractor for each category of work identified, unless sub-contractors vary with bid alternates, in which case the bidder must indicate which sub-contractor will be used for which alternate(s). If a category of work listed above will not be sub-contracted, the bidder must list itself. Failure to name such sub-contractors or itself shall render the bidder's bid non-responsive.

C. Name Subcontractors for the fields of work pre-listed regardless of percentage or contract value.

1. _____

2. _____

3. _____

4. _____

1.4 BID FORM SIGNATURES

_____ _____

By (Name and Title) Signature

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION 00 41 20

DRAFT

AIA® Document A104™ – 2017

Standard Abbreviated Form of Agreement Between Owner and Contractor

AGREEMENT made as of the « » day of « » in the year « »
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

and the Contractor:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

for the following Project:
(Name, location and detailed description)

« »
« »
« »

The Architect:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

DRAFT

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TABLE OF ARTICLES

ARTICLE 1 THE WORK OF THIS CONTRACT

The Contractor shall execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 2 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 2.1 The date of commencement of the Work shall be:
(Check one of the following boxes.)

[« »] The date of this Agreement.

[« »] A date set forth in a notice to proceed issued by the Owner.

[« »] Established as follows:

(Insert a date or a means to determine the date of commencement of the Work.)

« »

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 2.2 The Contract Time shall be measured from the date of commencement.

§ 2.3 Substantial Completion

§ 2.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:
(Check the appropriate box and complete the necessary information.)

[« »] Not later than « » (« ») calendar days from the date of commencement of the Work.

[« »] By the following date: « »

§ 2.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date

§ 2.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 2.3, liquidated damages, if any, shall be assessed as set forth in Section 3.5.

ARTICLE 3 CONTRACT SUM

§ 3.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be one of the following:
(Check the appropriate box.)

[« »] Stipulated Sum, in accordance with Section 3.2 below

[« »] Cost of the Work plus the Contractor's Fee, in accordance with Section 3.3 below

[« »] Cost of the Work plus the Contractor's Fee with a Guaranteed Maximum Price, in accordance with Section 3.4 below

(Based on the selection above, complete Section 3.2, 3.3 or 3.4 below.)

§ 3.2 The Stipulated Sum shall be « » ($ « »), subject to additions and deductions as provided in the Contract Documents.

§ 3.2.1 The Stipulated Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:
(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)

« »

§ 3.2.2 Unit prices, if any:
(Identify the item and state the unit price and the quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit ($0.00)

§ 3.2.3 Allowances, if any, included in the stipulated sum:
(Identify each allowance.)

Item	Price

§ 3.3 Liquidated damages, if any, as outlined in Article 14:
(Insert terms and conditions for liquidated damages, if any.)

$500 Dollars per Day
For each calendar day after said time for Substantial Completion that the Work remains not substantially complete, and
$300 Dollars per Day
For each calendar day in excess of 45 days after Substantial Completion that the Final Completion is not attained, as certified by the Architect. »

ARTICLE 4 PAYMENT

§ 4.1 Progress Payments

§ 4.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 4.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

« »

§ 4.1.3 Provided that an Application for Payment is received by the Architect not later than the «fifth» day of a month, the Owner shall make payment of the certified amount to the Contractor not later than the «fifteenth» day of the «following» month. If an Application for Payment is received by the Architect after the date fixed above, payment shall be made by the Owner not later than «forty five» («45») days after the Architect receives the Application for Payment.
(Federal, state or local laws may require payment within a certain period of time.)

§ 4.1.4 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold retainage from the payment otherwise due as follows:
(Insert a percentage or amount to be withheld as retainage from each Application for Payment and any terms for reduction of retainage during the course of the Work. The amount of retainage may be limited by governing law.)

«5%»

§ 4.1.5 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

«12» % «Twelve Percent»

§ 4.2 Final Payment

§ 4.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Section 18.2, and to satisfy other requirements, if any, which extend beyond final payment;

.2 the Contractor has submitted a final accounting for the Cost of the Work, where payment is on the basis of the Cost of the Work with or without a Guaranteed Maximum Price; and

.3 a final Certificate for Payment has been issued by the Architect in accordance with Section 15.7.1.

§ 4.2.2 The Owner's final payment to the Contractor shall be made no later than 45 days after the issuance of the Architect's final Certificate for Payment, or as follows:

« »

ARTICLE 5 DISPUTE RESOLUTION

§ 5. 1 RESOLUTION OF CLAIMS AND DISPUTES

§ 5.1.1 Pursuant to Article 21, All Claims, disputes and other matters in question of the Contractor arising out of, or relating to, the Contract Documents or the breach thereof (i.e., "Claims"), except claims which have been specifically waived under the terms of the Contract Documents, shall be decided exclusively by the following dispute resolution procedure unless the parties mutually agree in writing otherwise.

§ 5.1.2 The Contractor's timely written notice of claim, as provided in 5.1.2 above, shall provide the Owner with the amount of the claim and the extent of any claim for a change in the Contract Time with supporting data prior to the Level I meeting described below, unless the Owner agrees in writing to a continuance of the Level I meeting to ascertain more accurate supporting data. The notice shall be deemed to include a statement that the claim covers all changes in cost and in time (direct, indirect, impact, and consequential) to which the Contractor is entitled. Prior to being obliged to attend the Level II meeting, the Owner or its representatives shall have the right to audit the books and records of the Contractor and of any subcontractor of any tier making a Claim.

§ 5.1.2.1 Level I Within seven days of receipt of the written notice, the senior site representative of the contractor, the project representative of the Architect, and the project representative of the Owner shall meet, confer, and attempt to resolve the claim.

§ 5.1.2.2 Level II If the claim is not resolved within seven days of the close of the Level I meeting, an officer of the Contractor (who did not attend the Level I meeting), a principal of the Architect, and the Owner's senior representative (who did not attend the Level I meeting), shall meet, confer, and attempt to resolve the claim within seven days thereafter.

§ 5.1.2.3 The terms of the resolution of all claims concluded in Level I or II meetings shall be memorialized in writing and signed by each party immediately upon conclusion of the meeting (s).

§ 5.1.2.4 Mediation If, after the above two meetings, the claim is not resolved, the Contractor may bring no claim against the Owner in litigation unless the claim is first subject to non-binding mediation before a single mediator under the Voluntary Construction Mediation Rules of the American Arbitration Association. This requirement cannot be waived except by an explicit written waiver signed by the Owner. An officer of the Contractor and the Senior Representative of the Owner, both having full authority to settle the claim, must attend the mediation session. To the extent there are other parties in interest, such as subcontractors or suppliers, their representatives, with full authority to settle the claim, shall also attend the mediation session. Unless the Owner and the Contractor mutually agree in writing otherwise, all unresolved claims shall be considered at a single mediation session which shall occur prior to Final Acceptance by the Owner.

§ 5.1.2.5 Litigation The Contractor may bring no litigation on claims unless such claims have been properly raised and considered in the procedures of subparagraphs 15.2.1 and 15.2.2.4 above. All unresolved claims shall be waived and released unless the Contractor has strictly complied with the time limits of the Contract Documents, and litigation is served and filed within the earlier of (a) 60 days after Final Acceptance, of (b) 120 days after Substantial Completion. This requirement cannot, and shall not, be waived except by an explicit written waiver signed by the Owner.

§ 5.2.3 The Contractor shall diligently carry on the Work and maintain the Construction Network during any dispute resolution proceedings, unless otherwise agreed by it and the Owner in writing,

§ 5.2.4 The Contractor agrees that the Owner may join the Contractor as a party to any litigation/arbitration involving the Project in any way. All disputes shall be decided by litigation in strict accordance with the time limits prescribed in the Contract.

§ 5.2.5 Notwithstanding the above, the Owner may demand arbitration, before a single arbitrator appointed by the American Arbitration Association under the Expedited Procedure of the Construction Industry Arbitration Rules within five days of the demand, for the purpose of seeking a declaratory judgment regarding the propriety of the Owner's prospective termination of the contractor. The hearing shall occur within seven days of the appointment of the arbitrator, and the award shall be made within two days of the close of the hearing and shall be final and binding.

ARTICLE 6 ENUMERATION OF CONTRACT DOCUMENTS

§ 6.1 The Contract Documents are defined in Article 7 and, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 6.1.1 The Agreement is this executed AIA Document A104™–2017, Standard Abbreviated Form of Agreement Between Owner and Contractor.

§ 6.1.2 The Specifications:

(Either list the Specifications here or refer to an exhibit attached to this Agreement.)

« »

Section	Title	Date	Pages

§ 6.1.3 The Drawings:

(Either list the Drawings here or refer to an exhibit attached to this Agreement.)

« »

Number	Title	Date

§ 6.1.4 The Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are enumerated in this Article 6.

§ 6.1.5 Additional documents, if any, forming part of the Contract Documents:

.1 Other documents, if any, listed below:

(List here any additional documents that are intended to form part of the Contract Documents.)

« »

ARTICLE 7 GENERAL PROVISIONS

§ 7.1 The Contract Documents

The Contract Documents are enumerated in Article 6 and consist of this Agreement (including, if applicable, Supplementary and other Conditions of the Contract), Drawings, Specifications, Addenda issued prior to the execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 7.1.1 In case of conflict in the Contract Documents, notify Architect and obtain written instructions before proceeding.

§ 7.1.2 The Contractor shall provide all items shown or described in the Documents and perform all operations required, and shall furnish all labor, materials, equipment, services, required for their completion, including incidental items and services not specifically shown or described but necessary for proper completion of the work shown.

§ 7.1.3 Wherever in the Contract Documents an article, item of work, device, or piece of equipment is referred to in the singular number, such reference shall include as many such items or operations as are indicated on the Drawings or required to complete the installation.

§ 7.1.4 Specification and Drawing notes may include incomplete sentences where words such as "shall", "shall be", "the Contractor shall", and similar phrases shall be supplied by inference.

§ 7.1.5 The terms "approved", "or approved" and "as approved" mean approved by the Architect, and by any governing codes and officials, and by any quality standards specified as applicable to the work in question.

§ 7.1.6 The term "As directed" means as directed by the Architect.

§ 7.1.7 The term "provide" means to furnish and install.

§ 7.1.8 The terms "as required" and/or “as necessary” means as required by applicable codes or standards, and/or as may be required for proper completion of the work.

§ 7.1.9 Divisions and Sections included are listed in the "Table of Contents", together with the number of pages in each Section. The Contractor shall check his copies of the Specifications with the "Table of Contents" to ensure that they are complete.

§ 7.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind between any persons or entities other than the Owner and the Contractor.

§ 7.3 The Work

The term “Work” means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor’s obligations. The Work may constitute the whole or a part of the Project.

§ 7.4 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect’s consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 7.5 Ownership and use of Drawings, Specifications and Other Instruments of Service

§ 7.5.1 The Architect and the Architect’s consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and will retain all common law, statutory and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect’s or Architect’s consultants’ reserved rights.

§ 7.5.2 The Contractor, Subcontractors, Sub-subcontractors and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to the protocols established pursuant to Sections 7.6 and 7.7, solely

and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect's consultants.

§ 7.6 Digital Data Use and Transmission

The parties shall agree the transmission and use of Instruments of Service or any other information or documentation in digital form. is provided for the limited purpose of assisting the Contractor, Subcontractors, and Suppliers in the preparation of their shop drawings, cursory material takeoffs and/or site staking. Users acknowledge the electronic media supplied contains work in progress, are subject to change without notice, and may not accurately represent the scope or configuration of work noted, dimensioned, or specified in the contract documents. Contractor shall note that dimensions of the electronic work may not accurately reflect the noted dimensions or placement by shop drawings, notes and accurate adjustments to integrate with other materials and systems.

§ 7.7 Digital Data Use and Reliance

Use of the electronic media by the Contractor, Subcontractors, and Suppliers shall be at the Contractor's sole risk and without liability, risk, or legal exposure to the Owner or Architect and the Contractor agrees to release and, to the fullest extent permitted by law, defend, indemnify, and hold harmless the Owner, Architect, Architect's consultants, agents, and fees arising from or relating to any such use by the Contractor or third parties.

§ 7.8 Severability

The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 7.9 Notice

§ 7.9.1 Except as otherwise provided in Section 7.9.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, or by courier, or as otherwise set forth below:

« »

§ 7.9.2 Notice of Claims shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 7.10 Relationship of the Parties

Where the Contract is based on the Cost of the Work plus the Contractor's Fee, with or without a Guaranteed Maximum Price, the Contractor accepts the relationship of trust and confidence established by this Agreement and covenants with the Owner to cooperate with the Architect and exercise the Contractor's skill and judgment in furthering the interests of the Owner; to furnish efficient business administration and supervision; to furnish at all times an adequate supply of workers and materials; and to perform the Work in an expeditious and economical manner consistent with the Owner's interests. The Owner agrees to furnish and approve, in a timely manner, information required by the Contractor and to make payments to the Contractor in accordance with the requirements of the Contract Documents.

§ 7.10 Common Reference Standards

Reference in the Specifications to known standards such as codes, standard specifications, etc., promulgated by professional or technical Associations, Institutes, Societies are intended to mean the latest edition of each such standard adopted and published as of the date of the Contract for the Work of this Project, except where otherwise specifically indicated. Each such standard referred to shall be considered a part of the Specifications to the same extent as if reproduced therein in full. The following is a representative, though partial, list of such organizations together with the abbreviation by which each is identified.

ACI	American Concrete Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
APWA	American Public Works Association (Including State Affiliates)
ASA	American Standards Association
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASTM	American Society of Testing and Materials
AWI	Architectural Woodwork Institute
AWSC	American Welding Society Code
CSI	Construction Specifications Institute
DOT	Washington State Department of Transportation
IBC	International Building Code, latest edition
IFC	International Fire Code, latest edition
NBFU	National Bureau of Fire Underwriters
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
UBC	Uniform Building Code, reference IBC
WABO	Washington Association of Building Officials
UL	Underwriters' Laboratories, Inc.
WH	Warnock Hersey Fire Laboratories

§ 7.10.1 Refer to individual sections of Specifications for other names and abbreviations of trade associations and standards applicable to specific portions of the Work. In particular, refer to Divisions 22 and 23 for names and abbreviations applicable to the mechanical work, and refer to Division 26 for names and abbreviations applicable to the electrical work.

ARTICLE 8 OWNER

§ 8.1 Information and Services Required of the Owner

§ 8.1.1 Prior to commencement of the Work, at the written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 8.1.1, the Contract Time shall be extended appropriately.

§ 8.1.2 The Owner shall furnish initial survey and a legal description of the site.

§ 8.1.3 The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work. Refer also to Paragraph 16.1.

§ 8.1.4 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 9.6.1, the Owner shall secure and pay for other necessary approvals, easements, assessments, and charges required for the construction, use, or occupancy of permanent structures or for permanent changes in existing facilities.

§ 8.2 Owner's Right to Stop the Work

If the Contractor fails to correct Work which is not in accordance with the requirements of the Contract Documents, or repeatedly fails to carry out the Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order is eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity.

§ 8.3 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents, and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to any other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both

subject to prior approval of the Architect and the Architect may, pursuant to Section 15.4.3, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including the Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 21.

ARTICLE 9 CONTRACTOR

§ 9.1 Review of Contract Documents and Field Conditions by Contractor

§ 9.1.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

§ 9.1.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 8.1.2, shall take field measurements of any existing conditions related to that portion of the Work and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies, or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional unless otherwise specifically provided in the Contract Documents.

§ 9.1.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 9.2 Supervision and Construction Procedures

§ 9.2.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall be fully and solely responsible for the jobsite safety thereof unless the Contactor gives timely written notice to the Owner and Architect that such means, methods, techniques, sequences or procedures may not be safe.

§ 9.2.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for or on behalf of the Contractor or any of its Subcontractors.

§ 9.2.2.1 The Contractor shall be responsible for all cutting, fitting or patching that may be required to complete the Work or to make its several parts fit together properly. Cutting and patching work shall be done by skilled workmen experienced in handling the materials being worked.

§ 9.2.2.2 The Contractor shall not structurally damage or endanger any portion of the Work or the work of the Owner or any separate contractors by cutting, patching the existing building(s) or improvements, or otherwise altering any work, or by excavation. The Contractor shall not cut or otherwise alter the work of the Owner or any separate Contractor except with the written consent of the Owner and of such separate Contractor. The Contractor shall not unreasonably withhold from the Owner or any separate Contractor his consent to cutting or otherwise altering the Work.

§ 9.3 Labor and Materials

§ 9.3.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 9.3.2 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

§ 9.3.3 The Contractor may make a substitution only with the consent of the Owner, after evaluation by the Architect and in accordance with a Modification.

§ 9.4 Warranty

The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation or normal wear and tear under normal usage. All other warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 15.6.3.

§ 9.4.1 Testing Laboratory Labels:

All materials and equipment for which UL, NBFU or WH standards have been established, and their label service available, shall bear the appropriate UL, NBFU or WH label.

§ 9.4.2 Manufacturers' Trademarks and Names

The Architect reserves the right to review and request the removal of the manufacturers' trademarks on all materials and equipment which will be in plain view of the occupants of the building when placed in final position. Such removal shall be at no expense to the Owner. A decision on the necessity to remove or redesign may be obtained from the Architect in writing prior to bidding. Failure to obtain such approval shall constitute agreement to comply with such decision at a later date.

§ 9.4.3 In addition to the contractual guarantees contained in the General Conditions of the Contract, the Contractor shall obtain and furnish to the Architect written manufacturers'/installers' guarantees for all equipment, fixtures, assemblies and installations provided under the Contract, as called for in the Specifications and customarily available. Furnish with each guarantee: Date guarantee period starts, name, address and telephone number of the guarantor's representative nearest to Project, who, upon request of the Owner, will honor the guarantee during the guarantee period and provide services prescribed in guarantee. Refer to General Conditions and submit in conformance with Section 01 33 00, SUBMITTALS.

§ 9.5 Taxes

The Contractor shall pay sales, consumer, use, and other similar taxes that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 9.6 Permits, Fees, Notices, and Compliance with Laws

§ 9.6.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for permits, fees, licenses, and inspections by government agencies, such as Washington State Labor and Industries, necessary for proper execution and completion of the Work, excluding utility connection charges/fees and/or startup 'use fees', that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 9.6.1.1 Plan Check fees and Building Permit fees to the Building Department of the governing jurisdiction **SHALL** be paid by the Owner. In addition, charges by serving utilities SHALL be paid by the Owner. It shall be the Contractor's responsibility to determine all additional fees which have, or have not, been paid, and to obtain and pay for all required permits and fees not already paid for or noted to be paid by the Owner.

§ 9.6.1.2 The Contract Sum, and any agreed variations thereof, shall also include all taxes imposed by law, including business and occupation taxes, except Washington State Sales Tax. State Sales Tax will be paid by the Owner. A proportionate amount of the sales tax will be added to each payment voucher issued to the Contractor.

§ 9.6.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work. If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 9.7 Allowances

The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. The Owner shall select materials and equipment under allowances with reasonable promptness. Allowance amounts shall include the costs to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts. Contractor's costs for unloading and handling at the site, labor, installation, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowance.

§ 9.8 Contractor's Construction Schedules

§ 9.8.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 9.8.2 The Contractor shall perform the Work in general accordance with the most recent schedule submitted to the Owner and Architect.

§ 9.9 Submittals

§ 9.9.1 The Contractor shall review for compliance with the Contract Documents and submit to the Architect Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents in coordination with the Contractor's construction schedule and in such sequence as to allow the Architect reasonable time for review. By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them; (2) determined and verified materials, field measurements, and field construction criteria related thereto, or will do so; and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents. The Work shall be in accordance with approved submittals.

§ 9.9.2 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents.

§ 9.10 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 9.11 Cutting and Patching

The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly.

§ 9.12 Cleaning Up

The Contractor shall at all times keep the premises free from accumulation of waste materials or rubbish caused by his operations. At the completion of the Work he shall remove, from and about the Project, any remaining waste materials and rubbish, as well as all his tools, construction equipment, surplus materials, sample panels, etc., and properly dispose of such at his expense. Refer also to detailed requirements in Section 01 74 00.

§ 9.12.1 Final clean-up of the Work shall include the following:

1) All floors and interior finished surfaces shall be vacuumed clean and dust free. Apply and buff out one coat approved wax to all resilient floorings (unless non-wax type).

2) Wash and polish all glass inside and outside. This work shall be done by persons experienced, skilled and equipped for such work.

3) Remove foreign matter, marks, stains, splatters of paint, roofing materials, etc., fingerprints, soil and dirt from all finished surfaces, whether interior or exterior, and from all hardware, fixtures and incorporated equipment.

4) Replace all HVAC filters and clean grilles, registers, ducts, blowers and coils if air handling units are operated during construction.

§ 9.12.2 The foregoing provisions shall apply to all areas of new construction, and also to any areas or portions of the existing building(s) and improvements that are in any way affected by the Work of this Contract.

§ 9.12.3 If the Contractor fails to properly clean up upon completion of the Work, the Owner may do so and the cost thereof shall be charged to the Contractor.

§ 9.13 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 9.14 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 9.15 Indemnification

§ 9.15.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section 9.15.1.

§ 9.15.2 In claims against any person or entity indemnified under this Section 9.15 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 9.15.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts. After mutual negotiation of the parties, the Contractor waives immunity as to the Owner and Architect only under industrial insurance, Title 51 RCW. IF THE CONTRACTOR DOES NOT AGREE WITH THIS WAIVER, IT MUST PROVIDE A WRITTEN NOTICE TO THE OWNER PRIOR TO THE DATE FOR THE RECEIPT OF BIDS, OR THE CONTRACTOR WILL BE DEEMED TO HAVE WAIVED THIS IMMUNITY.

§ 9.16 The Architect will furnish one clean full size set of Drawings and Specifications to the Contractor to be maintained as Project Record. Record Drawings and Specifications shall be maintained daily not used by the Contractor, shall be kept up-to-date during the entire course of the Work and shall be available on request for examination by the Architect and, when necessary to establish current configurations and clearances for other parts of the Work.

§ 9.16.1 Record Drawings shall be maintained accurately and neatly and as approved by the Architect. The following information shall be clearly shown on the Record Documents:

1) All deviations from sizes, locations, detail or other features of installation as shown in the original Contract Documents. These shall be recorded whether covered by Change Order, Field Order, or effected by Contractor's option.

2) Final, accurate locations of underground and all other concealed items, dimensioned to column lines, walls, fire hydrants, survey monuments or other permanent features. All turns, invert elevations and rates of all piping runs shall be verified and accurately noted or shown.

§ 9.16.2 For work concealed in the building, sufficient information shall be given to allow future location with reasonable accuracy and ease. In some cases this may be by dimension. In others, it may be sufficient to accurately illustrate the Work on the Drawings in relation to parts of the building near which it was installed.

§ 9.16.3 Complete Record Documents, maintained as approved by the hereinbefore described are a necessary and mandatory part of the construction process. The Work shall not be considered complete until they are completed and returned to the Architect, **nor will partial payment for any part of the Work be authorized unless Record Documents applicable to that portion of the Work are current and accurate to date.**

§ 9.17 All operations of the Contractor, his subcontractors and employees, including but not limited to, construction, fabrication, delivery, storage, stockpiling, parking and incidental movement or access, shall be contained within the 'Contract Limits' indicated on the Drawings, if any, or if no such limits are shown, within the boundaries of the Owner's contiguous property.

§ 9.17.1 Contractor shall take all necessary measure to regulate vehicle and pedestrian traffic as necessary, limiting access to designated routes and parking to designated locations.

ARTICLE 10 ARCHITECT

§ 10.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction, until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents, unless otherwise modified in writing in accordance with other provisions of the Contract.

§ 10.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld. Nothing contained in this Section or in other portions of the Contract Documents shall be construed as requiring the Architect to direct the method or manner of performing any work under this Contract or to be responsible for the Contractor's performance in any respect.

§ 10.3 The Architect will visit the site at intervals appropriate to the stage of the construction to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general, if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences, or procedures, or for safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 10.4 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 10.5 Based on the Architect's evaluations of the Work and of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 10.6 The Architect has authority to reject Work that does not conform to the Contract Documents and to require inspection or testing of the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or

charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the work.

§ 10.7 The Architect will review and approve or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 10.8 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect will make initial decisions on all claims, disputes, and other matters in question between the Owner and Contractor but will not be liable for results of any interpretations or decisions rendered in good faith.

§ 10.9 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

ARTICLE 11 SUBCONTRACTORS

§ 11.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site.

§ 11.2 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the Subcontractors or suppliers proposed for each of the principal portions of the Work. The Contractor shall not contract with any Subcontractor or supplier to whom the Owner or Architect has made reasonable written objection within ten days after receipt of the Contractor's list of Subcontractors and suppliers. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 11.3 Contracts between the Contractor and Subcontractors shall (1) require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by the Contract Documents, assumes toward the Owner and Architect, and (2) allow the Subcontractor the benefit of all rights, remedies and redress against the Contractor that the Contractor, by these Contract Documents, has against the Owner.

§ 11.4 Except for those certain rights of information and reasonable objection as stipulated hereinbefore under this Article, the Owner shall have no involvement with, or responsibility for or accruing from, the Contractor's sub-contracts. The (Prime) Contractor is the only party to the agreement with the Owner and is fully responsible to the Owner for the performance of all the work of the Contract. Which portions, if any, of the Work the Contractor chooses to sub-contract to other parties shall be entirely the Contractor's choice, and responsibility, and all consequences of such sub-contracting shall accrue solely to the Contractor.

ARTICLE 12 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 12.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 12.2 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's activities with theirs as required by the Contract Documents.

§ 12.3 The Owner shall be reimbursed by the Contractor for costs incurred by the Owner which are payable to a Separate Contractor because of delays, improperly timed activities, or defective construction of the Contractor. The Owner shall be responsible to the Contractor for costs incurred by the Contractor because of delays, improperly timed activities, damage to the Work, or defective construction of a Separate Contractor.

ARTICLE 13 CHANGES IN THE WORK

§ 13.1 By appropriate Modification, changes in the Work may be accomplished after execution of the Contract. The Owner, without invalidating the Contract, may order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, with the Contract Sum and Contract Time being adjusted accordingly. Such changes in the Work shall be authorized by written Change Order signed by the Owner, Contractor, and Architect, or by written Construction Change Directive signed by the Owner and Architect. Upon issuance of the Change Order, Field Order, or Construction Change Directive, the Contractor shall proceed promptly with such changes in the Work, unless otherwise provided in the Change Order, Field Order, or Construction Change Directive.

§ 13.2 Adjustments in the Contract Sum and Contract Time resulting from a change in the Work shall be determined by mutual agreement of the parties or, in the case of a Construction Change Directive signed only by the Owner and Architect, by the Contractor's cost of labor, material, equipment, and reasonable overhead and profit, unless the parties agree on another method for determining the cost or credit. Pending final determination of the total cost of a Construction Change Directive, the Contractor may request payment for Work completed pursuant to the Construction Change Directive. The Architect will make an interim determination of the amount of payment due for purposes of certifying the Contractor's monthly Application for Payment. When the Owner and Contractor agree on adjustments to the Contract Sum and Contract Time arising from a Construction Change Directive, the Architect will prepare a Change Order.

§ 13.3 The Architect will have authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work.

§ 13.4 If concealed or unknown physical conditions are encountered at the site that differ materially from those indicated in the Contract Documents or from those conditions ordinarily found to exist, the Contract Sum and Contract Time shall be equitably adjusted as mutually agreed between the Owner and Contractor; provided that the Contractor provides notice to the Owner and Architect promptly and before conditions are disturbed.

§ 13.5 It shall be the responsibility of the Contractor before proceeding with any change to satisfy himself that the change has been properly authorized on behalf of the Owner. No change in the Contract will be allowed unless the change has been authorized in writing by the Owner, and the compensation or method thereof is stated in such written authority.

§ 13.5.1 Claims for extra costs will not be considered unless the claim is based on a written order signed by the Owner and Architect excepting only as provided for work in an emergency affecting the safety of life or the work or of adjoining property.

§ 13.6 Contract Unit Prices, as bid, shall remain valid and in force during the term of the Work, (except as provided for above,) and shall be reconciled with the total construction cost before filing of Notice of Completion.

§ 13.6.1 Unit Prices shall not apply to work which the Contractor may elect to do for his own convenience, nor to work required to correct errors, or unacceptable work of the Contractor.

§ 13.7 Should the Contractor encounter conditions differing substantially from those indicated in the Contract Documents, or unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract, which changed or unusual conditions will be considered by the Contractor as the basis for a claim for extra compensation, the Contractor shall promptly and before any such conditions are disturbed, notify the Owner through the Architect, of the alleged conditions in writing.

§ 13.7.1 If the Owner is not given written notice prior to the conditions being disturbed, the Contractor will be deemed to have waived any claim or claims for extra compensation in any manner arising out of the changed or unusual conditions.

§ 13.7.2 If the Owner shall determine the conditions to be such as to justify a claim for additional compensation, he may provide for additional payment for the particular phase of work in question by a negotiated agreement with the Contractor based on unit prices if provided for in the Contract, or by any other equitable arrangement mutually agreed upon by the Owner and the Contractor and consented to in writing.

§ 13.7.3 In any event, the Contractor shall proceed with other elements of the Work that are not affected by the alleged changed conditions pending execution of a Change Order if a claim is recognized under the above provisions.

§ 13.8 The Contractor's margin (mark-up) for overhead and profit, added to his actual labor and material, or subcontract cost, of work proposed to be done under change order, shall not exceed the percentages as bid and stipulated in the Agreement, (or if no percentages are so stipulated, shall be reasonable, and comparable to prevailing practice at the time and location of the Work).

§ 13.9.1 "Labor costs" as used herein may include mandatory labor taxes and mandatory benefits. All other costs, including general taxes, fees, increased bond and insurance costs, superintendence, administration, support, etc., shall be covered by the stipulated overhead and profit mark-up.

§ 13.9.2 If additional permits, connection charges, or "use fees" are legally required **due to a change order**, the Owner will reimburse the Contractor for the actual cost of such charges.

§ 13.9.3 Sub-contractors shall be generally bound by the provisions of this Article and their overhead and profit mark-up shall be reasonable and comparable to prevailing practice at the time and location of the Work. If sub-contractors are determined by the Architect to be unreasonable in this regard, the Contractor shall cooperate in obtaining alternative sub-bids for the work proposed.

ARTICLE 14 TIME

§ 14.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing this Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 14.2 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 14.3 The term “day” as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 14.4 The date of Substantial Completion is the date certified by the Architect in accordance with Section 15.6.3.

§ 14.5 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) changes ordered in the Work; (2) by labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions not reasonably anticipatable, unavoidable casualties, or any causes beyond the Contractor’s control; or (3) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine, subject to the provisions of Article 21.

§14.5.1 Except for substantial and unreasonable delays caused by acts or omissions of the Owner, persons acting on behalf of the Owner, or separate contractors employed by the Owner, the Contractor’s sole remedy for delay shall be extension of the Contract Time, and it shall not be entitled to damages or additional compensation for direct, indirect or “impact” costs of any kind due to delays.

§14.5.2 In the event substantial and unreasonable delays caused by the acts or omissions of the Owner, persons acting on behalf of the Owner or separate contractors employed by the Owner, the Contractor may be entitled to damages or equitable compensation therefore, provided:

1) Contractor shall give written notice of claim to the Owner and Architect, in accordance with Article 21, that such delay is pending or has commenced. No damage or adjustments shall be allowed for any day prior to receipt of such notice.

2) Based on the difficulties and disputes commonly attending claims based on delay, the parties specifically agree that the Contractor's maximum compensation for damages due to delay, including direct, indirect or impact damage of every nature, shall not exceed the same daily sums state herein as liquidated damages du the Owner for Contractor delay during the applicable period (i.e., before substantial completion or after).

§ 14.6 It is expressly understood and agreed by and between the Contractor and the Owner that the time for completion of the Work described herein is reasonable and acceptable taking into account the average yearly climatic conditions at the site of the Work and recognizing the possibility that inclement weather may temporarily stop work.

§ 14.6.1 For purposes of establishing a basis for evaluating the effect of the inclement weather on this Project and its completion date, the Owner and Contractor agree that the construction period stipulated herein allows for 30 lost working days every 12 months due to such inclement weather. For this purpose a lost working day is defined as a regular 8-hour working day during which the total work force on the Project is reduced to less than 25% of the average of the previous 3 days of full force employment when unaffected by weather. For each such lost working day exceeding the stated and expected 30, 1 day of time extension will be added to the Contract completion date. No adjustment in completion date will be made if lost working days total less than 2-1/2 days per month.

§ 14.6.2 Therefore, in the event that the Contract is not completed within the stipulated time or by, or prior to, a date to which the time for completion may have been extended, the Contractor and his surety shall be liable for, and shall pay to the Owner, as liquidated damages but not as a penalty, the sum(s) as outlined in Paragraph 3.3.

§ 14.6.3 Because of the difficulty in computing the actual damages which will result, the amount of Liquidated Damages as set forth above are hereby estimated, agreed upon and determined in advance by the parties hereto as a reasonable forecast of the actual damages which the Owner will suffer by the failure of the Contractor to complete the Work within the stipulated time, or prior to a date to which the period of completion may have extended.

§ 14.6.4 In the event that separately usable parts of the Work are substantially completed by the stipulated date for completion, the liquidated damages may be reduced proportionately, as determined by the Architect.

§ 14.6.5 The Contractor further agrees that any such deduction or payment shall not in any degree release the Contractor from further obligations and liabilities in respect to the fulfillment of the entire Contract.

§ 14.6.6 Liquidated Damages shall not be assessed the Contractor for days for which an extension of time will have been granted, or for delays which are beyond the control of the Contractor, or for delays caused by actions or neglect of the Owner or any of its officers or employees, but no such allowance shall be made unless a claim therefor is presented in writing to the Owner within 5 days after the occurrence of such delay, and the contractual time for completion is duly extended.

ARTICLE 15 PAYMENTS AND COMPLETION

§ 15.1 Schedule of Values

§ 15.1.1 Where the Contract is based on a Stipulated Sum or the Cost of the Work with a Guaranteed Maximum Price pursuant to Section 3.2 or 3.4, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Stipulated Sum or Guaranteed Maximum Price to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy required by the Architect. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 15.1.2 The allocation of the Stipulated Sum or Guaranteed Maximum Price under this Section 15.1 shall not constitute a separate stipulated sum or guaranteed maximum price for each individual line item in the schedule of values.

§ 15.2 Control Estimate

§ 15.2.1 Where the Contract Sum is the Cost of the Work, plus the Contractor's Fee without a Guaranteed Maximum Price pursuant to Section 3.3, the Contractor shall prepare and submit to the Owner a Control Estimate within 14 days of executing this Agreement. The Control Estimate shall include the estimated Cost of the Work plus the Contractor's Fee.

§ 15.2.2 The Control Estimate shall include:

.1 the documents enumerated in Article 6, including all Modifications thereto;

.2 a list of the assumptions made by the Contractor in the preparation of the Control Estimate to supplement the information provided by the Owner and contained in the Contract Documents;

.3 a statement of the estimated Cost of the Work organized by trade categories or systems and the Contractor's Fee;

.4 a project schedule upon which the Control Estimate is based, indicating proposed Subcontractors, activity sequences and durations, milestone dates for receipt and approval of pertinent information, schedule of shop drawings and samples, procurement and delivery of materials or equipment the Owner's occupancy requirements, and the date of Substantial Completion; and

.5 a list of any contingency amounts included in the Control Estimate for further development of design and construction.

§ 15.2.3 When the Control Estimate is acceptable to the Owner and Architect, the Owner shall acknowledge it in writing. The Owner's acceptance of the Control Estimate does not imply that the Control Estimate constitutes a Guaranteed Maximum Price.

§ 15.2.4 The Contractor shall develop and implement a detailed system of cost control that will provide the Owner and Architect with timely information as to the anticipated total Cost of the Work. The cost control system shall compare the Control Estimate with the actual cost for activities in progress and estimates for uncompleted tasks and proposed changes. This information shall be reported to the Owner, in writing, no later than the Contractor's first Application for Payment and shall be revised and submitted with each Application for Payment.

§ 15.2.5 The Owner shall authorize preparation of revisions to the Contract Documents that incorporate the agreed-upon assumptions contained in the Control Estimate. The Owner shall promptly furnish such revised Contract Documents to the Contractor. The Contractor shall notify the Owner and Architect of any inconsistencies between the Control Estimate and the revised Contract Documents.

§ 15.3 Applications for Payment

§ 15.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 15.1, for completed portions of the Work. The application shall be notarized, if required; be supported by all data substantiating the Contractor's right to payment that the Owner or Architect require; shall reflect retainage if provided for in the Contract Documents; and include any revised cost control information required by Section 15.2.4. Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 15.3.2 With each Application for Payment where the Contract Sum is based upon the Cost of the Work, or the Cost of the Work with a Guaranteed Maximum Price, the Contractor shall submit payrolls, petty cash accounts, receipted invoices or invoices with check vouchers attached, and any other evidence required by the Owner to demonstrate that cash disbursements already made by the Contractor on account of the Cost of the Work equal or exceed progress payments already received by the Contractor plus payrolls for the period covered by the present Application for Payment, less that portion of the progress payments attributable to the Contractor's Fee.

§ 15.3.3 Payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment stored, and protected from damage, off the site at a location agreed upon in writing.

§ 15.3.4 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the

Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or other encumbrances adverse to the Owner's interests.

§ 15.4 Certificates for Payment

§ 15.4.1 Prior to submittal of his first Application for Payment, the Contractor shall submit, in form and detail as approved by the Architect, a Schedule of Values allocated to the various portions of the Work. This Schedule, as approved, will serve as the basis for certification of the Contractor's Application for Payment.

§ 15.4.1.2 The Schedule of Values shall allocate, as a line item, a minimum of 2% of the Contract Sum (in addition to stipulated retainage) to "Project Closeout" work including "Completion/Correction List" items, record documents, final cleaning, lien releases, etc.

§ 15.4.1.3 Applications for payment shall be based on the previously approved Schedule of Values, and represent the value of labor and materials incorporated in the Work, and of all stable materials suitably stored at the site, or approved, bonded storage up to and including the last day of the preceding month, less the aggregate total of all previous payments.
Until the Work is complete, the Owner will pay 95% of all amounts due the Contractor on account of progress payments. The remaining 5% being withheld as retainage as provided for under Washington State Law.

§ 15.4.1.4 However, after the Work is 95% complete, the Contractor may request that the total amount of retainage be reduced to 100% of the value of the work remaining on the Project and, if the manner of completion of the Work and its progress are and remain satisfactory to the Architect, and in the absence of other good and sufficient reasons, the Architect may, on presentation by the Contractor of Consent of Surety, certify for, and the Owner make, subsequent payments in such amounts as will adjust the amount of retainage to an amount equal to the portion of the Contract Sum not then certified for payment.

§ 15.4.1.5 Prior to first Application for Payment the Contractor shall exercise in writing to the Owner, one of the following options:

§ 15.4.1.6 Retained percentage will be:

a) Retained in a fund by the Owner until 45 days following the final acceptance of the Work as completed; or

b) Placed in escrow in a mutually selected bank or trust company until 45 days following the final acceptance of the Work completed.

c) Addressed by a Bond, pursuant to RCW 60.28, as acceptable to the Owner and the Washington State Department of Revenue, in the amount of 5% of the total original Contract Sum, plus Washington State Sales Tax, with the provisions for increases and/or decreases in the Contract Sum as the project progresses.

§ 15.4.1.7 If the Contractor, option b), as set forth above, is selected, an escrow account shall be established in a financial institution selected by the Contractor and approved by the Owner, upon commencement of the Work.

§ 15.4.1.8 If the Prime Contractor receives interest on the retainage, then the subcontractors shall receive interest from the Prime Contractor on the amount of retainage withheld from payments due them by the Prime Contractor, subject to the negotiated terms and conditions of the sub-contract.

§ 15.4.1.9 The escrow agreement shall provide that the financial institution will act as escrow agent. Compensation to the escrow agent for establishing and maintaining the escrow account shall be paid from interest accrued in the account.

§ 15.4.1.10 As each progress payment is made, the retainage with respect to that payment shall be deposited by the Owner in the escrow account. When the Work has been fully completed in a satisfactory manner and the owner has approved final payment, the escrow agent shall pay to the Contractor the full amount of funds remaining in the account, including net balance of the interest paid to the account.

§ 15.4.1.11 Payments for materials or equipment items stored on or off the site shall be based on the Contractor's receipted purchase invoice amount (i.e., Contractor's cost).

§ 15.4.1.12 Upon satisfactory submittal of an Application for Payment to the Architect, not later than the third working day of the month, the Owner will make partial payment to the Contractor on the basis of a duly certified approved estimate of the work performed up to the 30th day of the previous month.

§ 15.4.1.13 The Contractor shall include with each Application for Payment, after the first, a notarized affidavit stating that all subcontractors and suppliers have been paid, less earned retainage, as their interest appeared in the last payment received. No Application for Payment will be processed unless accompanied by such notarized affidavit and statement.

§ 15.4.1.14 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor's, the escrow agent shall make payment to the Contractor as may be mutually agreeable to the Owner and Contractor.

§ 15.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluations of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 15.4.3 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 15.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 15.4.1. If the Contractor and the Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 9.2.2, because of

- **.1** defective Work not remedied;
- **.2** third-party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- **.4** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- **.5** damage to the Owner or a Separate Contractor;
- **.6** reasonable evidence that the Work will not be completed within the Contract Time and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- **.7** repeated failure to carry out the Work in accordance with the Contract Documents.

§ 15.4.4 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 15.4.3, in whole or in part, that party may submit a Claim in accordance with Article 21.

§ 15.5 Progress Payments

§ 15.5.1 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate

agreement with each Subcontractor, require each Subcontractor to make payments to sub-subcontractors in a similar manner.

§ 15.5.2 Neither the Owner nor Architect shall have an obligation to pay or see to the payment of money to a Subcontractor or supplier except as may otherwise be required by law.

§ 15.5.3 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 15.5.4 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 15.6 Substantial Completion

§ 15.6.1 Substantial Completion is 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 that the Owner can occupy or utilize the Work for its intended use. Substantial Completion will not be awarded earlier the date or days set forth in the Form of Proposal, unless so determined by the Architect on the date Substantial Completion is achieved. No other act by the Owner or Architect shall be construed to authorize issuance of a Certificate of Substantial Completion prior to the date or days set forth in the Form of Proposal.

§ 15.6.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 15.6.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. When the Architect determines that the Work or designated portion thereof is substantially complete, the Architect will issue a Certificate of Substantial Completion which shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 15.6.3.1 When the Architect determines that the Work is fully completed, he will certify for payment based on 100% completion, less retainage.

§ 15.6.3.2 Upon notification by the Contractor that the work of the Contract is substantially complete, the Architect, his Consultants, and the Owner, will conduct a 'pre-final inspection' making note of any apparent, non-conforming, incomplete or unsatisfactory items of Work. These items will be assembled into a 'Completion/Correction List' and attached to the Certificate of Substantial Completion.

§ 15.6.3.3 After proper completion of all Work under the Contract, the Contractor shall submit a letter addressed to Architect stating that the Contractor, or his superintendent in charge of job, has personally made a complete inspection of the job and that all items contained in the 'Completion/Correction List', or not in conformance with Plans and Specifications, have been completed; and that entire Project is ready for final inspection by Architect and Owner. This letter shall be accompanied by a copy of the Architect's 'Completion/Correction List' with each line item initialed and dated by the person responsible for execution of that particular item of work.

§ 15.6.3.4 Upon receipt of written notice that the work is ready for final inspection and acceptance, and upon receipt of a 100% Completion Application for Payment, the Architect (and Owner) will promptly make such inspection. When the Architect determines that the work has been fully and properly completed, he will certify for payment based on 100% completion, less retainage. This Certification for Payment shall also constitute certification by the

Architect, to the Owner, that to the best of his knowledge, based on his observations at the site and other information available, the work has been completed in accordance with the terms and conditions of the Contract Documents.

§ 15.6.3.5 If the final inspection reveals any defect in the Work, under the Contract Documents, such defects shall be repaired or unsatisfactory work replaced as the Architect may require, and no extension of the Contract time will be granted because of the time required to remedy such defects.

§ 15.6.3.6 If the Architect is required to make more than one 'Completion/ Correction List' or conduct additional inspections and/or follow-up administration and monitoring, after the scheduled final inspection in order to determine that all items on the 'Completion/Correction List' have been finally and properly corrected, the cost of his time expended in so doing, including travel, administrative and clerical time, shall be paid for by the Contractor, either directly, or by deduction from the Contract sum with such monies being used instead to compensate the Architect.

§ 15.6.4 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 15.7 Final Completion and Final Payment

§ 15.7.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions stated in Section 15.7.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 15.7.2 Final payment shall not become due until the Contractor has delivered to the Owner a complete release of all liens and claims arising out of this Contract or receipts in full covering all labor, materials and equipment for which a lien and/or claim could be filed, or a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien and/or claim remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including costs and reasonable attorneys' fees. Payment of the retained percentage shall be withheld for a period of 30 days following certification of 100% completion payment by the Architect, and shall be paid the Contractor at the expiration of said 30 days in event no claims, as provided by law, have been filed against such funds and the Contractor has delivered to the Owner a complete release of all claims arising out of this Contract or receipts in full covering all labor, materials and equipment for which a claim could be filed, or a bond satisfactory to the Owner indemnifying him against any such claim; and provided further that releases have been obtained from the State Department of Labor and Industries (including Final Affidavit of Legal Wages paid) and also the Washington State Tax Commission, the State of Washington Employment Security Department, and all other departments and agencies having jurisdiction over the activities of the Contractor. In the event any such claims are filed, the Contractor shall be paid said retained percentages less an amount sufficient to pay any such claims, together with a sum sufficient to pay the costs of legal action, including attorneys' fees.

§ 15.7.2.1 Contractor shall coordinate with the Owner's representative as required to see that required `Notice(s) of Completion of Public Works Project' is filed with the appropriate agencies in a timely manner.

§ 15.7.3 The making of final payment shall constitute a waiver of claims by the Owner except those arising from

- **.1** liens, claims, security interests or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents;
- **.3** terms of special warranties required by the Contract Documents; or
- **.4** audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 15.7.4 Acceptance of final payment by the Contractor, a Subcontractor or supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of the final Application for Payment.

ARTICLE 16 PROTECTION OF PERSONS AND PROPERTY

§ 16.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

.1 employees on the Work and other persons who may be affected thereby;

.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and

.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation, or replacement in the course of construction.

The Contractor shall comply with, and give notices required by, applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities bearing on safety of persons and property and their protection from damage, injury, or loss. The Contractor shall promptly remedy damage and loss to property caused in whole or in part by the Contractor, a Subcontractor, a sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 16.1.2 and 16.1.3. The Contractor may make a claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 9.15.

§ 16.1.2 The Contractor shall take particular care to protect existing improvements including, but not limited to, underground utilities, landscaping and adjoining property and structures, and to avoid damage thereto. He shall, at his own expense, completely repair any damage thereto caused by his operations.

§ 16.1.3 As a convenience to the Contractor, the Contract Documents attempt to show the approximate location of existing underground utilities and items to the extent that they are known, but neither the Owner nor the Architect can or does purport to know or guarantee that all such utilities and items are shown or that indicated locations are accurate.

§ 16.1.4 Any of the above described damages, if repaired by others, shall be charged to the Contractor.

§ 16.1.5 Work in place that is subject to injury because of operations carried on adjacent thereto shall be covered, boarded up or substantially enclosed with adequate protection. Permanent openings used as thoroughfares for the introduction of work and materials to the structure shall have heads, jambs and sills well blocked and boarded. All forms of protection shall be constructed in such manner that on completion, the entire Work will be delivered to Owner in unblemished conditions.

§ 16.2 Hazardous Materials and Substances

§ 16.2.1 The site of the Work (existing building) and adjunct improvements have not been fully surveyed by a qualified professional to determine what, if any, asbestos-containing materials or PCB's may exist within the limits of the Work. The Owner and Architect are not aware of the existence of any such materials, and are reasonably certain that none do exist within the limits of the Work. However, aforesaid reasonable certainty notwithstanding, it shall be the Contractors' sole responsibility to protect his workers, suppliers, all other properly interested parties, and the General Public, from the possibility of friable asbestos or PCB contamination should such material(s) be encountered.

§ 16.2.2 If materials containing, or reasonably suspect of containing, friable asbestos, PCB's (Polychloronatedbiphenyl), or other material generally recognized as being highly hazardous are encountered, the Contractor shall immediately stop work in the area affected, secure the area, and notify the Owner and the Architect. Sampling and testing of materials will be conducted and, if necessary, a system of work area containment and methods of abatement (removal or encapsulation) will be developed. If agreeable to both parties, a change order may be written to cover the Contractor's additional time and costs, or, the Owner may arrange to have abatement work done under separate contract. In an extreme case, the Owner may at his option, suspend or abandon the Project as provided in Article 12 of this Agreement.

§ 16.2.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area, if in fact, the material or substance presents the risk of bodily injury or death as described in Section 16.2.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 16.2.4 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

§ 16.3 The Contract Documents, the Contractor and his operations throughout the joint and several phases of construction shall be governed at all times by applicable provisions of the applicable Federal, State and local laws and ordinances, including but not limited to, the latest amendments of the following:

1) Williams-Steiger Occupation Safety and Health Act of 1970, Public Law 91-956.
2) Part 1910 - Occupational Safety and Health Standards, Chapter 17 of Title 29, Code of Federal Regulations.
3) Part 1518 - Safety and Health Regulations for Construction, Chapter 13 of Title 29, Code of Federal Regulations.
4) Safety Standard for Construction - Washington State Department of Labor and Industries (most current edition).
5) General Safety Standards - Washington State Department of Labor and Industries.

§ 16.3 PROTECTION OF EXISTING TREES AND VEGETATION

Location of existing trees, vegetation and improvements is approximate. Make field adjustments as required and directed by the Architect.

§ 16.3.1 Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavation materials within drip line, excess foot or vehicle traffic, or parking of vehicles within drip line. Contractor shall provide temporary guards to protect trees and vegetation to remain as directed or required.

§ 16.3.2 Contractor shall water and maintain all trees and other vegetation which are to remain within the limits of the Project as required to maintain their health during the course of construction operations.

§ 16.3.3 Contractor shall provide protection for roots over 1" diameter of plants to remain which are cut during construction. Coat the cut faces with an approved emulsified asphalt or other acceptable tree wound coating. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible. Roots of trees shall not be exposed in excavations for more than (1) working day.

§ 16.3.4 Contractor shall repair or replace damaged trees and vegetation as required by the Architect. Trees which cannot be repaired shall be replaced with tree, or plant of type, size and shape similar to the one(s) damaged, as approved.

§ 16.4 DUST AND SMOKE CONTROL

The Contractor shall constantly maintain the entire work area free from dust and smoke which would cause a hazard or nuisance to nearby streets, orchards, crops, residences, businesses, or the operations of other performing work in the area, by sprinkling and other approved methods, as required.

§ 16.4.1 The Contractor is cautioned that dust can be a severe problem in the locality of the Work. No separate payment will be made for dust and smoke control which the Contractor will be required to provide. All costs involved in dust and smoke control shall be included in the Contract Sum.

§ 16.4.2 In the event that the Contractor does not adequately control dust, the Owner reserves the right to contract separately for additional dust control, and deduct the cost involved from the Contract Sum. Further, the Owner will

not be responsible for any damage to the Work under the Contract resulting from separate dust control operations made necessary by the Contractor's failure to provide adequate dust control.

ARTICLE 17 INSURANCE AND BONDS

§ 17.1 Contractor's Insurance

§ 17.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in this Section 17.1 or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the insurance required by this Agreement from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 18.4, unless a different duration is stated below:

« »

§ 17.1.2 Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than «one million dollars » ($ «1,000,000 ») each occurrence, «two million dollars » ($ «2,000,000 ») general aggregate, and «two million dollars » ($ «2,000,000 ») aggregate for products-completed operations hazard, providing coverage for claims including

- **.1** damages because of bodily injury, sickness or disease, including occupational sickness or disease, and death of any person;
- **.2** personal and advertising injury;
- **.3** damages because of physical damage to or destruction of tangible property, including the loss of use of such property;
- **.4** bodily injury or property damage arising out of completed operations; and
- **.5** the Contractor's indemnity obligations under Section 9.15.

§ 17.1.3 Automobile Liability covering vehicles owned by the Contractor and non-owned vehicles used by the Contractor, with policy limits of not less than «one million dollars » ($ «1,000,000 ») per accident, for bodily injury, death of any person, and property damage arising out of the ownership, maintenance, and use of those motor vehicles along with any other statutorily required automobile coverage.

§ 17.1.4 The Contractor may achieve the required limits and coverage for Commercial General Liability and Automobile Liability through a combination of primary and excess or umbrella liability insurance, provided such primary and excess or umbrella insurance policies result in the same or greater coverage as those required under Section 17.1.2 and 17.1.3, and in no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers.

§ 17.1.5 Workers' Compensation at statutory limits.

§ 17.1.6 Employers' Liability with policy limits not less than «one million dollars » ($ «1,000,000 ») each accident, « one million dollars » ($ «1,000,000 ») each employee, and «two million dollar » ($ «2,000,000 ») policy limit.

§ 17.1.7 The Contractor shall provide certificates of insurance acceptable to the Owner evidencing compliance with the requirements in this Section 17.1 at the following times: (1) prior to commencement of the Work; (2) upon renewal or replacement of each required policy of insurance; and (3) upon the Owner's written request. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the period required by Section 17.1.1. The certificates will show the Owner as an additional insured on the Contractor's Commercial General Liability and excess or umbrella liability policy.

§ 17.1.8 The Contractor shall disclose to the Owner any deductible or self- insured retentions applicable to any insurance required to be provided by the Contractor.

§ 17.1.9 To the fullest extent permitted by law, the Contractor shall cause the commercial liability coverage required by this Section 17.1 to include (1) the Owner, the Architect, and the Architect's Consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions for which loss occurs during completed operations. The additional insured coverage

shall be primary and non-contributory to any of the Owner's general liability insurance policies and shall apply to both ongoing and completed operations. To the extent commercially available, the additional insured coverage shall be no less than that provided by Insurance Services Office, Inc. (ISO) forms CG 20 10 07 04, CG 20 37 07 04, and, with respect to the Architect and the Architect's Consultants, CG 20 32 07 04.

§ 17.1.10 Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by this Section 17.1, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 17.1.11 Other Insurance Provided by the Contractor
(List below any other insurance coverage to be provided by the Contractor and any applicable limits.)

Coverage	Limits

§ 17.2 Owner's Insurance
§ 17.2.1 Owner's Liability Insurance
The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

§ 17.2.2 Property Insurance
§ 17.2.2.1 The Owner shall purchase and maintain, from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located, property insurance written on a builder's risk "all-risks" completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis. The Owner's property insurance coverage shall be no less than the amount of the initial Contract Sum, plus the value of subsequent Modifications and labor performed or materials or equipment supplied by others. The property insurance shall be maintained until Substantial Completion and thereafter as provided in Section 17.2.2.2, unless otherwise provided in the Contract Documents or otherwise agreed in writing by the parties to this Agreement. This insurance shall include the interests of the Owner, Contractor, Subcontractors, and Sub-subcontractors in the Project as insureds. This insurance shall include the interests of mortgagees as loss payees.

§ 17.2.2.1.1 "Each claim may be subject to a DEDUCTIBLE OF UP TO $5,000.00. Losses up to the deductible amount shall be the responsibility of the Contractor".

§ 17.2.2.2 Unless the parties agree otherwise, upon Substantial Completion, the Owner shall continue the insurance required by Section 17.2.2.1 or, if necessary, replace the insurance policy required under Section 17.2.2.1 with property insurance written for the total value of the Project that shall remain in effect until expiration of the period for correction of the Work set forth in Section 18.4.

§ 17.2.2.3 If the insurance required by this Section 17.2.2 is subject to deductibles or self-insured retentions, the Owner shall be responsible for all loss not covered because of such deductibles or retentions.

§ 17.2.2.4 If the Work involves remodeling an existing structure or constructing an addition to an existing structure, the Owner shall purchase and maintain, until the expiration of the period for correction of Work as set forth in Section 18.4, "all-risks" property insurance, on a replacement cost basis, protecting the existing structure against direct physical loss or damage, notwithstanding the undertaking of the Work. The Owner shall be responsible for all co-insurance penalties.

§ 17.2.2.5 Prior to commencement of the Work, the Owner shall secure the insurance, and provide evidence of the coverage, required under this Section 17.2.2 and, upon the Contractor's request, provide a copy of the property insurance policy or policies required by this Section 17.2.2. The copy of the policy or policies provided shall contain all applicable conditions, definitions, exclusions, and endorsements.

§ 17.2.2.6 Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any insurance required by this Section 17.2.2, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 17.2.2.7 Waiver of Subrogation

§ 17.2.2.7.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by this Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this Section 17.2.2.7 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 17.2.2.7.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 17.2.2.7.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 17.2.2.8 A loss insured under the Owner's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements, written where legally required for validity, the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 17.2.2.9 Unless otherwise specifically agreed to in writing between the parties, the Owner's property insurance will not cover materials stored off-site or in transit. If the Contractor wishes to be paid for such materials prior to their being securely stored on-site, he will be required to furnish proof of adequate insurance thereon, at his expense.

§ 17.2.3 Other Insurance Provided by the Owner

(List below any other insurance coverage to be provided by the Owner and any applicable limits.)

Coverage	Limits

§ 17.3 Performance Bond and Payment Bond

§ 17.3.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in the Contract Documents on the date of execution of the Contract.

§ 17.3.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

ARTICLE 18 CORRECTION OF WORK

§ 18.1 The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed, or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense, unless compensable under Section A.1.7.3 in Exhibit A, Determination of the Cost of the Work.

§ 18.1.1 Failure of the Architect, or other Owner's representative to condemn, at any particular time, unsatisfactory material or reject inferior workmanship will in no way release the Contractor from his obligation to properly complete or correct such work, nor shall it be construed to mean the acceptance of such work. No compensation will be made for defective work or materials.

§ 18.1.2 Owner may require partial occupancy of certain portion of the Work during the period when the Work is still in progress and may request that such areas of the building receive concentrated work to allow such occupancy. This shall be done with consideration of the scheduling of the Work by the Contractor.

§ 18.1.2.1 As referred to here, early occupancy of such areas and the moving in of equipment, etc., by the Owner shall not be construed to constitute (Substantial Completion or) acceptance of any of the work performed under this Contract nor shall it be deemed to be the equivalent of the filing of the Notice of Completion of any of the work of this Contract. Provisions for acceptance, under certain circumstances, of portions of the work as being substantially complete are included in Article 9.8 above.

§ 18.1.2.2 Contractor shall be held harmless from any damage done to the Work as the result of early occupancy by the Owner.

§ 18.1.2.3 The Contractor shall make available, in the areas to be so occupied, any utility services, heating and cooling as are in condition to be put into operation at the time of such occupancy. All responsibility for such equipment shall remain with the Contractor while it is so operated prior to final acceptance of the work in these areas. However, an itemized list of each such piece of equipment with the date operation starts shall be prepared by the Contractor's and certified by Architect. This list shall be the basis for the commencement of the guarantee period on the equipment being operated for the benefit of the Owner's occupancy. Owner shall pay for all utility costs which arise out of occupancy by the Owner during construction.

§ 18.1.2.4 The Owner reserves the right to salvage any construction materials such as piping, and other materials, fixtures, etc., of value, as may be encountered. If such rights are exercised, the Owner shall execute such salvage as mutually agreed to with the Contractor, so as not to disrupt the Contractor's schedule or operations. If rights to such materials are (specifically) waived by the Owner, Contractor shall assume possession and/or dispose of them under the Contract. Certain items may be specifically noted for salvage under the Contract and shall be carefully removed by the Contractor and delivered to the Owner as directed.

§ 18.2 In addition to the Contractor's obligations under Section 9.4, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 15.6.3, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty.

§ 18.3 If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct it in accordance with Section 8.3.

§ 18.4 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 18.5 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Article 18.

ARTICLE 19 MISCELLANEOUS PROVISIONS

§ 19.1 Assignment of Contract

Neither party to the Contract shall assign the Contract without written consent of the other, except that the Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 19.2 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 21.6.

§ 19.3 Equal Opportunity Employment Policies: The Contractor and all subcontractors shall comply with RCW 49.60 in all respects and shall not discriminate against any employee or applicant for employment on account of race, religion, color, sex or national origin. The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rate of pay or other forms of compensation; and selection for training including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

§ 19.3.1 The Contractor and all subcontractors shall, in all solicitations or advertisements for employees placed by them on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex or national origin.

§ 19.4 Eight Hour Law and Payment for Labor: In compliance with RCW 49.28, the Contractor agrees that no laborer, workman, or mechanic in the employ of the Contractor, subcontractor, or other person doing or contracting to do the whole or any part of the work contemplated by this Contract, shall be permitted or required to work more than 8 hours in any one calendar day, provided that, in cases of extraordinary emergency, such as danger to life or property, the hours of work may be extended, but in such cases the rate of pay for time employed in excess of 8 hours of each calendar day shall be not less than 1-1/2 times the rate allowed for this same amount of time during 8 hours service. Any work necessary to be performed after regular working hours or on Sundays or legal holidays shall be performed without additional expense to the Owner.

§ 19.5 Legal Wages on Public Works: Legal wages shall be paid for all labor performed on the Work, as required by RCW 39.12, as amended.

§ 19.5.1 The Contractor shall not commence work until a certified copy of Form F700-029-000 "Statement of Intent to Pay Prevailing Wages on Public Works Contracts" is on file with the Owner, in compliance with the provisions of RCW 39.12, as amended. In addition, certified copies of Form F700-029-000 shall also be on file with the Owner for each subcontractor before the work of said subcontractor commences. Certification of Form F700-029-000 is obtained by filing said form in hard copy or digital form with the Director of Labor and Industries indicating wage to be paid to each classification of laborers, workmen or mechanics employed by the Contractor or subcontractors, which shall not be less than the prevailing rate of wage for an hour's work in the same trade or occupation in the locality of the work as determined by the Industrial Statistician. If the wage rates are correct, the Industrial Statistician will issue a certified acknowledgment of approval to the Contractor.

§ 19.5.2 If any incorrect wage rates are included, the Contractor and/or subcontractor will be notified of the correct rates by the Industrial Statistician and approval will be withheld until a correct statement is received. Upon receipt of certified copies by the Contractor, he shall distribute them in accordance with the instructions on the form, including submitting a certified copy to the Owner.

§ 19.5.3 For a Contract in excess of ten thousand dollars, a Contractor required to pay the prevailing rate of wage shall post in a location readily visible to workers at the job site:

1) A copy of a Statement of Intent to Pay Prevailing Wages, approved by the Industrial Statistician of the Department of Labor and Industries under RCW 39.12.040; and

2) The address and telephone number of the Industrial Statistician of the Department of Labor and Industries where a complaint or inquiry concerning prevailing wages may be made.

§ 19.5.4 The rules and regulations of the Department of Labor and Industries and the schedule of prevailing wage rates for the locality or localities where this Contract will be performed, as determined by the Industrial Statistician of the Department of Labor and Industries, are by reference made a part of this Contract, as though fully set forth herein.

§ 19.5.5 In case any dispute arises as to what are the prevailing rates of wages for work of a similar nature, and such dispute cannot be adjusted by the parties in interest, including labor and management representative, the matter shall be referred for arbitration to the director of the Department of Labor and Industries of the State and his decision therein shall be final and conclusive and binding on all parties involved in the dispute as provided for by RCW 39.12.060, as amended.

§ 19.5.6 Periodic Requests for Payment shall not be approved unless accompanied by Contractor's statement that prevailing wages have been paid in accordance with the pre-filed Statement of Intent, for the work covered by the request; and likewise, final payment shall not be approved until Final Affidavit of Legal Wages Paid, as certified by State of Washington Department of Labor and Industries' Industrial Statistician, has been received by the Owner.

§ 19.5.7 The Contractor shall indemnify and hold the Owner harmless from any penalties, claims or other costs, including attorneys fees, resulting from any real or alleged violation of RCW 39.12 by the Contractor or any of its sub-contractors of any tier.

§ 19.6 The Contractor and all subcontractors of any tier and those persons under their control shall fully comply with all applicable federal and state laws and regulations regarding a drug-free workplace, including the Drug-Free Workplace Act of 1988.

§ 19.6.1 Any person not fit for duty for any reason, including the use of alcohol, controlled substances, or drugs, shall immediately be removed from the Work.

§ 19.7 In accordance with RCW 70.160, Smoking is prohibited in Public places. This restriction is in force at all times, regardless of whether patrons are present.

§ 19.8 Apprenticeship Utilization Requirements

§ 19.8.1 Contractor shall comply fully with all provisions of RCW 39.04.320 which requires: "For contracts advertised on or after January 1, 2010, for all public works by a school district estimated to cost one million dollars or more, all specifications shall require no less than fifteen percent of the labor hours be performed by apprentices."

§ 19.8.2 Awarding agencies may adjust the requirements of RCW 39.04.320 for a specific project for the following reasons:

.1 The demonstrated lack of availability of apprentices in specific geographic areas;
.2 A disproportionately high ratio of material costs to labor hours, which does not make feasible the required minimum levels of participation;
.3 Participating contractors have demonstrated a good faith effort to comply with the requirements of RCW 39.04.30, 39.04.310 and 39.04.320; or
.4 Other criteria the awarding entity deems appropriate, which are subject to review by the office of the governor.

§ 19.8.3 With each application for payment, contractor shall submit a report which includes the following:

.1 Name of each apprentice and apprentice registration number.
.2 Number of apprentices and labor hours worked by them, categorized by trade or craft.
.3 Number of journey level workers and labor hours worked by them, categorized by trade or craft.
.4 If required, rational for request of exception per paragraph 13.15.2.

§ 19.8.4 A final summary report of information listed in sub-article 13.15.3 shall be submitted with the 100% completion application for payment.

§ 19.9 Tests and Inspections

Tests, inspections, and approvals of portions of the Work required by the Contract Documents or by applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 19.10 The Owner's representative:
(Name, address, email address and other information)

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§ 19.11 The Contractor's representative:
(Name, address, email address and other information)

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§ 19.11 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

ARTICLE 20 TERMINATION OF THE CONTRACT

§ 20.1 Termination by the Contractor

If the Architect fails to certify payment as provided in Section 15.4.1 for a period of 30 days through no fault of the Contractor, or if the Owner fails to make payment as provided in Section 4.1.3 for a period of 30 days, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 20.2 Termination by the Owner for Cause

§ 20.2.1 The Owner may terminate the Contract if the Contractor

- **.1** repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- **.2** fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- **.3** repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- **.4** otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 20.2.2 When any of the reasons described in Section 20.2.1 exists, the Owner, upon certification by the Architect that sufficient cause exists to justify such action, may, without prejudice to any other remedy the Owner may have and after giving the Contractor seven days' notice, terminate the Contract and take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor and may finish the Work by whatever reasonable method the Owner may deem expedient. Upon request of the Contractor,

the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 20.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 20.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 20.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Architect, upon application, and this obligation for payment shall survive termination of the Contract.

§ 20.3 Termination by the Owner for Convenience

The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause. The Owner shall pay the Contractor for Work executed; and costs incurred by reason of such termination, including costs attributable to termination of Subcontracts; and a termination fee, if any, as follows:
(Insert the amount of or method for determining the fee payable to the Contractor by the Owner following a termination for the Owner's convenience, if any.)

« »

ARTICLE 21 CLAIMS AND DISPUTES

§ 21.1 Claims, disputes, and other matters in question arising out of or relating to this Contract, including those alleging an error or omission by the Architect but excluding those arising under Section 16.2, shall be referred initially to the Architect for decision. Such matters, except those waived as provided for in Section 21.11 and Sections 15.7.3 and 15.7.4, may, after initial decision by the Architect or 30 days after submission of the matter to the Architect, be subject to mediation as a condition precedent to binding dispute resolution.

§ 21.2 Notice of Claims

§ 21.2.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 18.2, shall be initiated by notice to the Architect within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 21.2.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 18.2, shall be initiated by notice to the other party.

§ 21.3 Time Limits on Claims

The Owner and Contractor shall commence all claims and causes of action against the other and arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in this Agreement whether in contract, tort, breach of warranty, or otherwise, within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all claims and causes of action not commenced in accordance with this Section 21.3.

§ 21.4 If a claim, dispute or other matter in question relates to or is the subject of a mechanic's lien, the party asserting such matter may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 21.5 The parties shall endeavor to resolve their disputes by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with their Construction Industry Mediation Procedures in effect on the date of this Agreement. A request for mediation shall be made in writing, delivered to the other party to this Agreement, and filed with the person or entity administering the mediation. The request may be made concurrently with the binding dispute resolution but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order.

If an arbitration is stayed pursuant to this Section, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 21.6 If the parties have selected arbitration as the method for binding dispute resolution in this Agreement, any claim, subject to, but not resolved by, mediation may be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association, in accordance with the Construction Industry Arbitration Rules in effect on the date of this Agreement. Demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. Any award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 21.7 Claims, disputes and other matters in question arising out of or relating to the Contract that are not resolved by mediation, except matters relating to aesthetic effect and except those waived as provided for in Section 21.11 and Sections 15.7.3 and 15.7.4, **MAY**, by agreement of both parties, be decided by arbitration which, unless the parties mutually agree otherwise shall be in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association currently in effect. The demand for arbitration shall be filed in writing with the other party to this Agreement and with the American Arbitration Association and shall be made within a reasonable time after the dispute has arisen. **ANY** award rendered by the arbitrator or arbitrators shall be final, and judgement may be entered upon it in accordance with applicable law in any court having jurisdiction thereof. Except by written consent of the person or entity sought to or in any other manner, any person or entity not a party to the Agreement under which such arbitration arises, unless it is shown at the time the demand for arbitration is filed that (1) such person or entity is substantially involved in a common question of fact or law, (2) the presence of such person or entity is required if complete relief is to be accorded in the arbitration, (3) the interest or responsibility of such person or entity in the matter is not insubstantial, and (4) such person or entity is not the Architect or any of the Architect's employees or consultants. **ANY** agreement herein among the parties to the Agreement and any other written agreement to arbitrate referred to herein shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 21.8 Except as hereinbefore provided, the provisions of this Article pertaining to arbitration under this Contract, shall also apply to disputes between the Contractor and other prime contractors who may have contracts with the Owner to perform on the work on the site.

§ 21.9 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to this Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 21.10 Continuing Contract Performance

Pending final resolution of a Claim, except as otherwise agreed in writing, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 21.11 Waiver of Claims for Consequential Damages

The Contractor and Owner waive claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- **.1** damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- **.2** damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 20. Nothing contained in this Section 21.11 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

This Agreement entered into as of the day and year first written above.

OWNER *(Signature)*

« »« »

(Printed name and title)

CONTRACTOR *(Signature)*

« »« »

(Printed name and title)

SECTION 01 23 00 – BASE BID and ALTERNATES

In Addition to the Basic Provisions included in the CONDITIONS OF THE CONTRACT, the following requirements shall be strictly observed.

PART 1 – GENERAL

1.1 BASE BID WORK

A. The Base Bid Contract Sum shall include full compensation for all labor, materials, overhead, profit and appurtenant costs for all work shown and/or indicated in the Drawings and Specifications, together with all miscellaneous items of work reasonably required as incidental to proper accomplishment of the work shown, **EXCEPT**:

1. Work (construction or improvements) shown or indicated as 'existing' but not noted for removal, relocation or re-use under the Contract.

2. Work shown or indicated as 'by others' or 'Not in Contract' (N.I.C.), unless a fee or permit is required to be paid (i.e., sewer connection, water meter, etc.), as noted below.

3. Items of work included in the Schedule of Alternate below.

B. **Certain items of work (i.e., installation of water meters, electrical service connection, etc.), may be done by the serving utility or others but involve a fee or charge which shall be included in the Base Bid Sum as required by the Conditions of the Contract.**

1.2 ALTERNATE BIDS

A. Contractors (Bidders) shall state, in the spaces provided in the Form(s) of Proposal, Alternate Bids for the various parcels of work described below, and as further identified on the Drawings. Alternate Bid Sum(s) shall include full compensation for all labor, materials, overhead, profit and appurtenant costs for the work of each Alternate parcel of work, as scheduled and indicated, including all miscellaneous items of work reasonably required as incidental to proper accomplishment of the (alternate) work.

B. **Prime Bidders shall be responsible for coordinating with sub-contract bidders, so as to assure that Base Bid and Alternates include cost of all supporting elements required, and that no matter what combination of Base Bid and Alternates is accepted, the completed work of the Contract shall constitute a complete and properly functioning entity in itself. All work under Alternates shall be in strict accordance with all applicable Specification Sections.**

C. Numbering of Alternates does not imply the order in which Alternate bids may be accepted. The Owner reserves the right to accept, and/or reject, any Alternate Bids in order to provide whichever combination of Base bid and Alternates he determines will provide the best value for the Project as a whole.

D. The Contractor also shall guarantee his Alternate Bids for the period stipulated in the Form of Proposal, as being fair contract price for which he will accept a Change Order adding the various (alternate) parcels of work to the Contract.

1.3 SCHEDULE OF ALTERNATES

A. No alternates are included in the Contract Documents at this time, refer to any alternates added by Addenda.

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION 01 23 00

SECTION 01 25 00 – SUBSTITUTIONS and PRODUCT OPTIONS

In Addition to the Basic Provisions included in the CONDITIONS OF THE CONTRACT, the following requirements shall be strictly observed.

PART 1 – GENERAL

1.1 SUMMARY

A. For products specified only by reference standards, select any product meeting standards, by any manufacturer, subject to review by the Architect.

B. For products specified by naming several products or manufacturers, select any product and manufacturer named or submit proposed equivalents for prior approval as defined hereafter.

C. For products specified by naming only one product and manufacturer, there is no option, and no substitution will be allowed except by prior approval as defined hereafter.

1.2 SUBSTITUTIONS

A. During Bidding

1. Architect/Engineer will consider written requests, (on "Substitution Request" form provided hereinafter only) for substitutions, provided such requests are received at least 10 days (240 hours) prior to bid date and hour. Requests received after that time will not be considered.

2. Approvals, if any, of proposed substitutions will be by addenda to all bidders of record.

B. After Contract is Signed

1. The Agreement is based upon the items and materials specified in the Contract Documents. In signing the Agreement, the Contractor warrants that he has verified availability and delivery in order to properly complete the Work within the stipulated time of completion, and agrees that these are the items and materials to be utilized in the Work.

2. During the term of the Contract, substitutions will be allowed in exceptional cases only, and under one or more of the following conditions:

a. Required for compliance with final interpretation of code requirements or insurance regulations.

b. Unavailability of specified products, through no fault of the Contractor.

c. Subsequent information discloses inability of specified products to perform properly or to fit in designated space.

d. Manufacturer/fabricator refusal to certify or guarantee performance of specified product as required.

e. When it is clearly seen, in the judgment of the Architect/ Engineer, a substitution would be substantially to the Owner's best interests, in terms of cost, time or other considerations.

3. The Architect's judgment as to equivalence and acceptability shall be final. Certain non-technical features, such as available color selection, and appearance, may be reason for approval or rejection.

C. Substitution Request

1. The Contractor shall submit 3 copies each of "Substitution Request Form" (included hereafter) which shall include, and or/be accompanied by, the following:

a. Complete data substantiating compliance of proposed substitution with Contract Documents.

1) For products:

a) Product identification, including manufacturer's name and address.

b) Manufacturer's literature.

i. Product description

ii. Performance and test data

iii. Reference standards

c) Samples

d) Name and address of similar projects on which product was used, and date of installation.

2) For construction methods:

a) Detailed description of proposed method.

b) Detail drawings clearly illustrating methods.

b. Itemized comparison of proposed substitution with product or method specified.

c. Data regarding changes in construction schedule and relation to separate contracts.

d. Accurate cost data on proposed substitution in comparison with product or method specified.

e. A self-addressed, stamped, envelope for return of Substitution Request Form. Substitutions may be rejected if self-addressed, stamped envelope does not accompany submittal.

D. In making request for substitution, Bidder/Contractor represents:

1. He has personally investigated proposed product or method, and determined that it is equal or superior in all respects to that specified. He will provide the same guarantee for substitution as for product or method specified. He will coordinate installation of accepted substitution into Work, making such changes as may be required for Work to be complete in all respects.

2. He waives all claims for additional costs related to substitution which consequently becomes apparent.

3. Cost data is complete and includes all related costs under this Contract, but excludes:

a. Costs under separate contracts

b. Architect/Engineer's redesign

E. Substitutions will not be considered if:

1. They are indicated or implied on Shop Drawings or Product Data submittals without request submitted in accordance with this Section and the General Conditions.

2. Acceptance would require substantial revision of Contract Documents.

1.3 PRODUCT LIST

A. Within 21 days date of Contract, submit to Architect/ Engineer 5 copies of complete list of all products which are proposed for installation.

1. Tabulate list by each Specification Section.

2. For products specified under referenced standards, include with listing of each product:

1) Name and address of manufacturer

2) Trade name

3) Model or catalog designation

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

SUBSTITUTION REQUEST FORM
(SUBMIT 3 COPIES)

TO: _____

PROJECT: _____

We hereby submit for consideration, following product instead of specified item for the above project.

SECTION _____ SPECIFIED ITEM

_____ _____

PROPOSED SUBSTITUION: _____

Attach technical data, including laboratory tests and samples as applicable.

Detailed comparison of the significant qualities (size, weight, durability, performance and similar characteristics, and including visual effect where applicable) for the proposed substitution in comparison with the original requirements.

List completely installation changes and changes to Drawings and Specifications required by proposal.

FILL IN THE BLANKS BELOW:

A. Does substitution require change in Drawing Dimensions? _____

B. What effect does substitution have on other trades? _____

C. Differences between proposed substitution and specified item? _____

D. Manufacturer's guarantees of proposed and specified items are:

_____Same _____Different (Explain on Attachment)

E. Name and address of 3 similar projects on which the product was used. _____ (Attach) _____

F. Contract completion date is _____Same _____Different (Attach)

Undersigned attests function and quality equivalent or superior to specified item and waives his rights to additional payment and time which may subsequently be necessitated, by failure of the substitution to perform adequately, and for the required work to make corrections thereof. The undersigned will pay for any resulting design changes, including engineering and detailing costs, required to accommodate this substitution and the original design intent.

SUBMITTED:

_____
Signature

_____
Firm

_____
Address

_____

Telephone _____

Date _____

For Use by Architect

_____Accepted _____Accepted as Noted

_____Not Accepted _____Received to Late

By: _____ Date: _____

Remarks: _____

_____

END OF SECTION 01 25 00

SECTION 01 29 73 – SCHEDULE OF VALUES

In Addition to the Basic Provisions included in the CONDITIONS OF THE CONTRACT, the following requirements shall be strictly observed.

PART 1 – GENERAL

1.1 SUMMARY

A. Submit to the Architect a Schedule of Values at least 10 days prior to submitting first Application for Payment.

B. Upon request by Architect, support values given with data that will substantiate their correctness.

C. Use Schedule of Values only as basis for Contractor's Application for Payment.

1.2 FORM OF SUBMITTAL

A. Submit typewritten Schedule of Values on an 'Application and Certification for Payment on Contract' form as provided for the Project by the Architect.

1.3 PREPARING SCHEDULE OF VALUES

A. Use Table of Contents of this Specification as general basis of format in listing costs of work specified under the separate DIVISIONS included herewith.

B. Also Refer to the mechanical and electrical Sections further detail of required breakdown of mechanical and electrical work.

C. The Schedule of Values shall also be clearly coordinated with the activities identified in the Construction Network Schedule as specified in Section 01 32 16, and shall allocate, as a line item, a minimum of 2% of the Contract Sum (in addition to stipulated retainage) to "Project Closeout" work between Substantial Completion and Final Completion.

D. Itemize separate line item cost for each of the following general cost items:

1. Performance and Payment Bonds
2. Insurance
3. Building Permit
4. Mobilization
5. Field Supervision (Superintendent) and Layout
6. Temporary Facilities and Controls
7. Project Closeout (2% minimum)

E. Itemize separate line item cost for each section of work. For each line item which has installed value of more than $20,000, break down costs to list major products or operations under each item. If it is intended to bill for material stored on site but not installed at time of billing (i.e., masonry, door frames, hardware, etc.) break line item into materials and labor.

F. Round off figures to nearest 10 dollars. Make sum of total costs of all items listed in Schedule equal to total Contract Sum.

1.4 REVIEW AND RESUBMITTAL

A. After review by Architect, revise and resubmit Schedule of Values as required. Resubmit revised Schedule in same manner.

PART 2 – PRODUCT

(Not used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION 01 29 73

SECTION 01 31 19 – PROJECT MEETINGS

In Addition to the Basic Provisions included in the CONDITIONS OF THE CONTRACT, the following requirements shall be strictly observed.

PART 1 – GENERAL

1.1 SUMMARY

A. Pre-Construction Meeting and Progress Meetings shall be scheduled and held as further detailed below. Person designated herein below shall:

1. Prepare and distribute written notice and agenda of regular and called meetings four days in advance of meeting date.
2. Make physical arrangements for meetings.
3. Preside at meetings.
4. Record minutes; include significant proceedings and decisions.
5. Distribute copies of minutes to attendees within four days of meeting.

1.2 PRE-CONSTRUCTION MEETING

A. Architect will schedule for date within 14 days after date of Notice of Acceptance, and conduct meeting.

B. Required Attendance:

1. Owner
2. Architect/Consultants
3. Contractor (Project Manager) and Superintendent
4. Major Subcontractors

C. Minimum Agenda:

1. Length of Contract and liquidated damages.
2. Performance Bond, Insurance Certificate, Schedule.
3. Sign and distribute Contract(s).
4. Notice to Proceed.
5. Contractor's authorized representatives.
6. Owner's Representatives/Architect/Inspector names and responsibilities.
7. Instruction to Contractor through A/E.
8. Instructions to Contractors in writing.
9. Progress Chart or CPM (Tentative Construction Schedule).
10. Progress Meetings and Reports.
11. Submittals.
12. Delayed start of work in certain areas.
13. Continuation of Owner's operations.
14. Temporary facilities.
15. Contractor's working hours.
16. Contractor's parking, access, storage, etc.
17. Items to be posted in office.

18. Permits status.
19. Coordination with utility companies.
20. Coordination with City (or County).
21. Staking and layout.
22. Quality Control (Special Inspection and Testing).
23. Owner furnished, Contractor installed items.
24. Existing material to be re-used on work.
25. Labor/Material breakdown (Schedule of Values).
26. Monthly payment.
27. Retention (Escrow) Bond.
28. Payments to Subcontractors.
29. Change Orders, time extensions, stop work orders, field orders.
30. Owner occupancy prior to construction completion.
31. Handling disputes.
32. Project Record Documents.
33. O & M Manuals.
34. Contract Closeout.
35. Other Items.

1.3 PROGRESS MEETINGS

A. Contractor shall schedule and conduct regular meetings; minimum of every other week. Exact day and time shall be established at the Pre-Construction Meeting.

B. Hold Called Meetings as exigencies of work dictate.

C. Location of Meetings: Project Site or adjacent location to be determined.

D. Required Attendance:

1. Owner's Representative
2. Architect/Consultants
3. Contractor
4. Subcontractors as pertinent to agenda

E. Minimum Agenda:

1. Review, approve minutes of previous meeting.
2. Review work progress since last meeting.
3. Estimate overall percentage of Work completed.
4. Note field observations, problems and decisions.
5. Identify problems which impede planned progress.
6. Review off-site fabrication problems.
7. Develop corrective measures and procedures to regain planned schedule.
8. Revise Construction Schedule as indicated.
9. Plan progress during next work period.
10. Review submittal schedules, expedite as required to maintain schedule.
11. Maintaining of quality and work standards:
    a. Effect on Construction Schedule
    b. Effect on completion date

12. Complete other current business.

F. Meeting Minutes shall be recorded by the Contractor with copies sent to Owner and Architect within three working days following each meeting.

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION 01 31 19

SECTION 01 32 16 – CONSTRUCTION SCHEDULES

In Addition to the Basic Provisions included in the CONDITIONS OF THE CONTRACT, the following requirements shall be strictly observed.

PART 1 – GENERAL

1.1 CONSTRUCTION NETWORK SCHEDULE

A. Congruent with requirements of the General Conditions of the Contract, the Contractor shall prepare a Network Analysis and Schedule (with review by and in coordination with other Prime Contractors for the Work, if any). The Network Analysis Schedule shall be of the type described in "CPM in Construction" published by the AGC (or other approved system capable of producing the desired planning, scheduling and control information) (such as a horizontal bar chart).

B. The Network Analysis shall include time scale diagrams which show the order and interdependence of activities and the sequence in which the work is to be accomplished as planned by the Contractor, and show how the start of a given activity is dependent on the progress or completion of preceding activities throughout the construction period.

C. Detailed Network activities shall show, in addition to construction activities, the submittal and approval of samples of materials and shop drawings, the procurement of critical materials and equipment and their installation. All activities of the Owner that affect progress shall be shown.

D. Mechanical and electrical subcontractors shall submit Network Analysis Diagrams for their work, to the General Contractor, designed to be integrated into the final Network prepared by the General Contractor.

E. The Contractor may select to shorten (accelerate) the allowed construction period (schedule) at his own discretion and complete the project ahead of the required completion date. However, float time shall be included in the schedule to represent the time allowed for completion of the work. Under no circumstances shall delays to the Contractor's accelerated schedule result in claims for additional cost or time to the Owner.

F. The **approved** Progress Network Analysis shall then be the Schedule to be used by the Contractors and others for planning, organizing and directing the Work and for reporting progress.

G. Diagrams shall be neatly drafted, showing preceding and succeeding event numbers for each activity and activity duration, flowing from left to right. The critical activity sequence (critical path) which controls the total required time to complete each segment and to complete the Project shall be identified on the diagrams. The float time for all activities shall be indicated.

H. The following minimum information shall be provided for each activity:

1. Activity number, description and duration estimate at time of computation.

2. Earliest possible and latest acceptable starting and completion dates.

3. Responsibility for activity (Prime Contractor, subcontractor, supplier, Owner, etc.).

I. **All scheduled activities shall also be clearly coordinated with the Schedule of Values specified in Section 01 29 73.**

J. Revision of the time scaled diagrams shall be required whenever a major change, or a succession of minor changes, occurs in scheduling which influences either the critical path or final completion date of the Project.

K. The schedule shall be updated as of the first day of each month to verify progress and areas needing more attention to complete Project during allotted time frame.

L. Within 7 days of Notice to Proceed (execution of Contract), Contractor shall submit for approval, name of personnel responsible for doing the scheduling and an illustrative example of the type of diagram intended. The Contractor, together with major subcontractors and suppliers, (i.e., mechanical, electrical, etc.,) shall participate with the Architect and Owner in a review and evaluation of the proposed network diagrams as required. The completed Network Analysis shall be submitted within 15 days following completion of review.

M. Initial submittal and all revisions shall be submitted in three copies, signed and dated by the Contractor.

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION 01 32 16

SECTION 01 33 00 – SUBMITTALS

In Addition to the Basic Provisions included in the CONDITIONS OF THE CONTRACT, the following requirements shall be strictly observed.

PART 1 – GENERAL

1.1 SUBMITTALS DEFINED

A. The term 'submittals' as used herein includes all shop drawings, field layouts, samples, color or model selections, material and equipment data and descriptions, certifications, schedules, guarantees, bonds, warranties and other items as called for in the various sections of the Contract Documents.

B. Requirements for Operating Maintenance Manuals and Record Documents are detailed separately in Sections 01 78 23 and 01 78 39, and respective Specification Sections.

1.2 REQUIRED PROCEDURE

A. Submittals not strictly conforming to the requirements of this Section will be returned forthwith for proper resubmittal, resultant delay in approval being the responsibility of the Contractor.

1.3 IDENTIFICATION

A. Completely identify each submittal and resubmittal by showing at least the following information:

1. Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.

2. Name of Project as it appears on the Contract Documents.

3. Drawing number and Specification Section number to which the submittal applies.

4. Whether this is an original submittal or resubmittal.

5. Provide 8" x 3" blank space for Contractor and Architect/Engineer's review stamp.

1.4 COORDINATION

A. Prior to submittal for Architect's review, use all means necessary to fully coordinate all material, including the following procedures:

1. Determine and verify all field dimensions and conditions, materials, catalog numbers, and similar data.

2. Coordinate as required with all trades and with all public agencies involved.

3. Secure all necessary approvals from public agencies and others and signify by stamp, or other means, that they have been secured.

4. Clearly indicate all deviations from the Contract Documents.

5. Unless otherwise specifically permitted by the Architect, make all submittals in groups containing all associated items; i.e., all electrical submittals together, all miscellaneous metal fabrications together; etc. The Architect may reject partial submittals as not complying with the provisions of the Contract Documents.

6. All submittals shall be sent to General Contractor before submission to Architect or Consultants. Upon completion of items 1 thru 5 above, the General Contractor shall then transmit submittals (to the Architect).

1.5 TIMING OF SUBMITTALS

A. In general all data and drawing submittals shall be in the Architect's hands within 30 days after execution of Contract. Refer also to various technical sections and log of submittals following.

B. In any event, make all submittals far enough in advance of scheduled dates of installation to provide all required time for review, for securing necessary approvals, for possible revision and resubmittal, and for placing orders and securing delivery in time to maintain Project schedule.

C. In scheduling, allow at least seven full working days for the Architect's review following his receipt of the submittals, and additional time as follows:

1. Submittals of **structural items** (i.e., steel detailing drawings, weld certificates, concrete mix design, etc.) and all submittals required under DIVISIONS 15 and 16, which require, a **minimum of ten full working days for review and return.**

2. **Submittals that require a color and/or pattern selection to be made will require a minimum of 21 days for approval, dating from the time that <u>ALL</u> submittals on items requiring color/pattern selections have been received by the Architect.**

D. Costs of delays occasioned by tardiness of submittals, including liquidated damages, may be backcharged to sub-contractors and/or suppliers as necessary, but shall not be borne by the Owner.

1.6 NUMBER OF COPIES REQUIRED

A. Submit one electronic copy to the Architect.

1.7 SHOP DRAWINGS

A. Defined Inclusions: The term 'Shop Drawings' as used herein shall also include job layout and installation drawings as may be required for the work as certain trades (i.e., reinforcing steel, suspended ceilings, casework, etc.), as well as shop fabrication drawings.

B. Format and Content: Make all drawings accurately to a scale sufficiently large to clearly show all pertinent features, method of fabrication, installation, and/or connection to the Work. Indicate size, type, dimension and location of all components, jointing, connections, etc.

C. Make all drawings (copies) with white background. Fold sheets larger than 11" x 17" neatly to 8-1/2" x 11" packet size with identifications, as specified above, visible on top fold.

1.8 SAMPLES

A. Furnish all samples called for in the Contract Documents in quantity as required above for other submittals.

B. Unless otherwise specifically directed by the Architect, all samples shall be of the precise article, material or finish proposed to be incorporated into the Work. **Photographic representations**, or other simulations of materials or finishes are **not acceptable**. Refer also to specific requirements in the various technical sections of these Specifications.

C. In certain cases, so noted in the specifications, samples too large for handling as outlined herein, may be prepared and maintained on the job site, and the Architect will waive retention of sample at the time of completion. These samples are also exempted from the quantity requirements stipulated above and may be furnished in single (approved) number, as directed.

1.9 COLORS

A. Unless the precise color and pattern is specifically described in the Contract Documents, whenever a choice of color or pattern is available in a specified product submit accurate color samples and pattern charts to the Architect for his review and selection.

B. Unless all available colors and patterns have identical costs and identical wearing capabilities, and are identically suited for the installation, completely describe the relative costs and capabilities of each.

C. **All items requiring color (or pattern) selection must be submitted before any selections/approvals can be made. The color scheme must be approved by the Owner as a whole, not piecemeal. ALL color selection submittals should be received as quickly after Contract execution as possible in order to avoid delay in ordering of certain long lead items.**

1.10 CERTIFICATIONS, GUARANTEES, BONDS & WARRANTIES

A. In addition to the Contractual guarantees required by the Agreement, General Conditions and Supplementary Conditions, furnish to the Architect, for forwarding to the Owner, all certifications, guarantees, bonds and warranties specifically called for in the Contract Documents, or ordinarily provided by manufacturers or suppliers of various portions of the Work.

B. Time of Submittal:

1. Certifications, guarantees, etc., or copies thereof of materials or equipment to be incorporated into the Work shall be furnished to the Architect upon delivery to site, and approved before installation.

2. Certifications, guarantees, etc., or copies thereof, of installations, applications or assemblies shall be furnished upon completion of that portion of the Work and prior to Substantial Completion.

1.11 LOG OF SUBMITTALS

A. The log following this Section is furnished for convenience only and may not include all items required for submittal under the Contract.

B. Items for which repeated submittals may be required, such as concrete load certificates, reinforcing steel drawings, etc., should be recorded on a separate log, but are included here as a reminder for initial and final processing.

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION 01 33 00

SECTION 01 35 00 – SPECIAL CONDITIONS

In Addition to the Basic Provisions included in the CONDITIONS OF THE CONTRACT, the following requirements shall be strictly observed.

PART 1 – GENERAL

1.1 NO ON-SITE BURNING ALLOWED

A. The Contractor shall not, under the work of this Contract, conduct any burning of slash, debris, scraps, wastage, etc., at the site, or on any property of the Owner's. The Contractor shall legally and appropriately dispose of all such material off-site. Should the Contractor choose to arrange for disposal burning at a remote site, of other ownership, he shall assume all related costs, risks and responsibilities, and shall hold the Owner harmless from any problems, complaints, challenges, losses or damages, whether legal, financial or otherwise, arising out of such burning operations.

1.2 BUILDING TESTS

1. The structure is to be constructed with a continuous air barrier at the perimeter of the thermal envelope. The contractor shall ensure that measures are taken to complete the air barrier system and obtain a passing building test for the system. See also Section 07 26 00 and 07 92 00.

2. All work shall be conducted and tested in conformance with the current edition of the Washington State Energy Code - Commercial.

    a. The air barrier shall be continuous for all assemblies that are the thermal envelope of the building and across the joints and assemblies.

    b. Air barrier joints and seams shall be sealed, including sealing transitions in places and changes in materials. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from the wind, stack effect and mechanical ventilation.

    c. Penetrations of the air barrier shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Sealing shall allow for expansion, contraction and mechanical vibration. Joints and seams associated with penetrations shall be sealed in the same manner or taped. Sealing materials shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the penetrations' ability to resist positive and negative pressure from wind, stack effect, and mechanical vibration. Sealing of concealed fire sprinklers, where required, shall be in a manner that is recommend by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.

    d. Where recessed lighting fixtures and similar objects which penetrate the air barrier are installed, provisions shall be made to maintain the integrity of the barrier.

3. The building areas enclosed by a thermal barrier shall be tested for air leakage in accordance with ASTM E779 or a method approved by the governing jurisdiction.

    a. Maximum Allowed Air Leakage:

        1) Tests shall be in accordance with the leakage noted on the drawings for specific efficiency options. Where no additional efficiency option for air leakage is noted, air leakage shall not exceed 0.25 cfm/ft^2 at a pressure differential of 0.3 inches water gauge.

    b. If the test rate exceeds that defined here, a visual inspection of the air barrier shall be conducted and any leaks noted shall be sealed until the test passes the requirements.

    c. A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the building owner and governing jurisdiction and shall also be posted in the building with the Thermal Envelope Certificate.

1.3 THERMAL ENVELOPE CERTIFICATE

A. A permanent thermal envelope certificate shall be completed by an approved party employed by the Contractor and posted on a wall in the space where the space conditioning equipment is located such as an equipment room, utility room or other location approved by the governing jurisdiction.

1. The certificate shall include the following:

    a. R-Values of insulation installed in or on ceilings, roofs, walls, foundations and slabs, crawlspace walls and floors, and ducts outside conditioned spaces.

    b. U-factors and solar heat gain coefficients (SHGC) of fenestration.

    c. Results from any building envelope air leakage testing performed on the building.

    d. Where there is more than one value for any component of the building envelope, the certificate shall indicate the area-weighted average value where available. If the area-weighted average is not available, the certificate shall list each value that applies to 10 percent or more of the total component area.

2. A template for the Thermal Envelope Certificate is attached and if acceptable to the governing jurisdiction, may be completed and posted.

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

THERMAL ENVELOPE CERTIFICATE

PROJECT: _____

Address: _____

Contractor: _____

Climate Zone: _____ Compliance Path: _____

INSULATION VALUES

List installed R-Value, leave space blank if not applicable

Roof Insulation Entirely Above Deck: _____ Area Weighted Y/N: _____
Roof of Metal Building: _____ Area Weighted Y/N: _____
Roof Insulation in Attic and Other: _____ Area Weighted Y/N: _____
Walls, Above Grade Mass Walls: _____ Area Weighted Y/N: _____
Walls, Transfer Deck Slab Edge: _____ Area Weighted Y/N: _____
Walls, Above Grade Metal Building: _____ Area Weighted Y/N: _____
Walls, Above Grade Steel Framed: _____ Area Weighted Y/N: _____
Walls, Above Grade Wood Framed/Others: _____ Area Weighted Y/N: _____
Walls, Below Grade: _____ Area Weighted Y/N: _____
Floors, Mass _____ Area Weighted Y/N: _____
Floors, Joist/Framing: _____ Area Weighted Y/N: _____
Ducts outside of thermal envelope _____ Area Weighted Y/N: _____

List installed U-Value, leave space blank if not applicable

Slab on Grade Floor, Unheated: _____ Area Weighted Y/N: _____
Slab on Grade Floor, Heated: _____ Area Weighted Y/N: _____
Swinging Door: _____ Area Weighted Y/N: _____
Nonswinging Door: _____ Area Weighted Y/N: _____
Garage Door < 14% glazing: _____ Area Weighted Y/N: _____
Garage Door > 14% <50% glazing: _____ Area Weighted Y/N: _____

List installed U-Value, SHGC-Value, leave space blank if not applicable

Window, Fixed: _____ _____ Area Weighted Y/N: _____
Window, Operable: _____ _____ Area Weighted Y/N: _____
Doors, Entry: _____ _____ Area Weighted Y/N: _____
Other Vertical Fenestration: _____ _____ Area Weighted Y/N: _____
Windows, Mix of Operable/Fixed _____ _____ Area Weighted Y/N: _____
Skylights _____ _____ Area Weighted Y/N: _____

BUILDING ENVELOPE AIR LEAKAGE TESTING

Measured Air Leakage _____ cfm/ft^2

By: _____ Date: _____

Company: _____

END OF SECTION 01 35 00

SECTION 01 45 00 – INDEPENDENT INSPECTION and TESTING

In Addition to the Basic Provisions included in the CONDITIONS OF THE CONTRACT, the following requirements shall be strictly observed.

PART 1 – GENERAL

1.1 SUMMARY

A. The Owner will employ, and pay for, services of an independent Special Inspector and/or Testing Laboratory to perform specified services.

B. Inspection, sampling, and testing is (may be) required for work identified in the structural drawings.

C. Testing, adjusting and balancing of mechanical HVAC (and plumbing) systems is addressed in Divisions 22 and 23.

D. Employment of testing laboratory shall in no way relieve Contractor of his obligation to perform work in accordance with the Contract.

1.2 QUALIFICATIONS OF INSPECTOR/LABORATORY

A. Meet "Recommended Requirements for Independent Laboratory Qualifications", latest edition, published by American Council of Independent Laboratories.

B. Meet basic requirements of ASTM E-329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction", latest edition.

C. Be approved by building official having jurisdiction over the Work.

1.3 TESTING EQUIPMENT

A. Calibrated at maximum 12-month intervals by devices of accuracy traceable to either:

1. National Bureau of Standards

2. Accepted values of natural physical constants

1.4 Submit copy of Certificate of Calibration, made by accredited calibration agency.

1.5 COSTS

A. Except where hereinafter specified "By Contractor", fees for normal inspection and tests will be paid by the Owner.

B. Additional inspection and tests required because of defective work or ill-timed notices shall be at Contractor's expense.

C. If the Contractor's work schedule or timing of work requires that special inspection must be performed on weekends or beyond the special inspector's typical work day, the Contractor may be required to pay the difference between the Inspector(s) overtime fees and regular fees. Contractor shall make all necessary arrangements with the Special Inspector. In no event shall the Owner be liable for additional or surcharged inspection fees incurred for the Contractor's convenience or due to the Contractor's irregular scheduling.

D. Expense of additional tests required due to negative or questionable results obtained by 'normal' or original testing shall be borne as determined in the General Conditions or as follows:

1. If tests indicate work does not meet specifications, cost paid by Contractor.

2. If tests indicate work does meet specifications, cost paid by Owner, except that if faulty procedure on the part of the Testing Laboratory can be demonstrated to be the cause of poor results from the original test, cost shall be paid by Testing Laboratory.

1.6 SPECIAL INSPECTOR/LABORATORY DUTIES – LIMITATIONS OF AUTHORITY

A. Cooperate with Architect/Engineer and Contractor; provide qualified personnel promptly on notice. Perform specified inspections, sampling and testing of materials and methods of construction.

1. Comply with specified standards; Building Code, ASTM, OSHA, other recognized authorities, and as specified.

2. Ascertain compliance with requirements of Contract Documents.

B. Promptly notify Architect, Contractor and building official of irregularities or deficiencies in work which are observed during performance of services.

C. Promptly submit (2) copies of reports of inspections and tests to Architect/Engineer plus 1 copy to building official and 1 copy to the Contractor. Reports shall include:

1. Date issued

2. Project title and number

3. Testing laboratory name and address

4. Name and signature of inspector

5. Date of inspection or sampling

6. Record of temperature and weather

7. Date of test

8. Identification of product and Specification Section

9. Location in project

10. Type of inspection or test

11. Observations regarding compliance with Contract Documents

D. Upon completion of the work the Special Inspector/Laboratory shall furnish a final report to the parties listed above, stating that, to the best of his knowledge, the work has been done in accordance with the plans and specifications.

E. Perform other additional services as required by Owner.

F. Special Inspector/Laboratory is not authorized to:

1. Release, revoke, alter, or enlarge on requirements of Contract Documents.

2. Approve, accept, or reject, any portion of the Work.

3. Perform any duties of the Contractor.

1.7 CONTRACTOR RESPONSIBILITIES

A. Notify laboratory at least 48 hours prior to any testing requirements during construction, for scheduling tests.

B. Cooperate with laboratory personnel. Provide access to work.

C. Provide to laboratory preliminary representative samples of materials to be tested in required quantities. Furnish proposed soils samples, copies of mix designs, 'truck tickets', mill test reports, etc., as requested.

D. Furnish casual labor and facilities:

1. To provide access to work to be tested

2. To assist in obtaining and handling of samples at the site

3. To facilitate inspections and tests

4. For laboratory's exclusive use in storage and curing of test samples.

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION 01 45 00

SECTION 01 50 00 – TEMPORARY CONSTRUCTION & SERVICES

In Addition to the Basic Provisions included in the CONDITIONS OF THE CONTRACT, the following requirements shall be strictly observed.

PART 1 – GENERAL

1.1 TEMPORARY SERVICES

A. The Contractor shall provide temporary power, water, sewer, and other utilities as required for performance of the Work. Contractor shall remove all temporary services promptly when no longer necessary.

B. Contractor shall be responsible for the installation, paying all costs incidental to, and removal, of a field telephone/facsimile machine. The Contractor's site superintendent shall also maintain a cellular phone in addition to the field telephone/facsimile machine unless the field telephone is equipped with an outside annunciator horn, or the office is staffed full time.

1.2 TEMPORARY LIGHTING, HEAT AND FIRE PROTECTION

A. Contractor shall provide adequate temporary lighting and convenience outlets in the Work, temporary structures, and elsewhere as may be necessary for proper performance and inspection of the Work. If operations are carried on during hours of darkness, adequate illumination shall be furnished and maintained by the Contractor during all hours that daylight is insufficient for the work in progress.

B. When required for proper installation or protection of any portion of the Work, the Contractor shall furnish and install, operate and maintain temporary heating units. Open salamanders or propane heaters shall not be used where smoke will damage finished work, humidity will affect insulation or interfere with satisfactory installation of finishes in any way.

C. When heating and ventilating systems are installed and operable, Contractor may arrange for temporary operation of the heating system, paying all costs of operation, provided that such operation does not affect the starting date of the manufacturers' warranty period on the equipment, unless such warranty date is specifically waived, in writing, by the Owner in consideration of other guarantees under the Contract.

D. Before the date of Substantial Completion, all registers, diffusers and filters shall be thoroughly cleaned or replaced.

E. Contractor shall provide and maintain fire extinguishers, fire hoses and other equipment necessary for fire protection during construction. Such equipment shall be used for fire protection only.

1.3 TEMPORARY STRUCTURES

A. All temporary buildings, trailers, and similar facilities shall be weather and water tight and shall be painted and maintained in a neat orderly appearance for the duration of the

Work. Temporary buildings other than approved trailers or pre-assembled buildings shall be provided with raised floors, solid sheathed composition roofs, adequate windows and substantial wood doors with provision for locking. They shall be located as approved by Architect/Owner.

B. The following minimum facilities shall be provided:

1. Contractor's Field Office in movable shed or trailer, and all structures necessary for the storage of tools, materials and equipment for Contractor and sub-contractors.

2. Temporary chemical toilet structures with urinals shall be provided in numbers as required, adequately sized, located and maintained in a clean and sanitary condition acceptable to legally constituted authorities.

3. Temporary barricades and/or covered passageways as may be required by Government, State or local, authorities, and as required to adequately protect the public, the Owners employees and patrons, the Contractor's workers, the Work, and existing and adjacent properties and improvements. Refer also to applicable provisions of the General Conditions and Supplementary General Conditions. Such facilities as are required shall be built by Contractor at no additional cost to the Owner and shall be painted and maintained in an orderly, neat appearance at all times.

4. Scaffolds, Ladders and Runways: Contractor shall furnish, erect and maintain for duration of the Work as required, and remove when the Work permits, all scaffolds, runways, guardrails, plat-forms, barricades and similar construction as may be necessary for the performance of the Work. Such facilities shall be of type and arrangement as required for their specific use; shall be substantially constructed throughout, strongly supported, well secured and shall comply with all applicable rules and regulations of applicable State and local codes.

5. Drinking water shall be provided from a proven, safe source, for those connected with the Work. The water shall be piped or transported in such a manner so as to keep it clean and fresh. Serve in single service containers or sanitary drinking fountains.

1.4 TEMPORARY DRAINAGE

A. Surface or sub-surface water or other fluids shall not be permitted to accumulate in excavations or in and about the premises or buildings. Should such conditions be encountered or develop, the fluid shall be controlled and suitably disposed of off-site by means of temporary pumps, piping, drainage lines, troughs, ditches, dams, or other methods.

B. Open wells and shafts shall be enclosed as required by OSHA and/or WISHA.

1.5 TEMPORARY PROTECTION OF OPENINGS

A. The Contractor shall provide temporary protections of all openings, passageways, doorways, etc. The Contractor shall protect all wall corners from damage by approved

means. Protection shall be at all openings where materials, workmen, etc., may damage frames, edges, corners, etc. Protection shall be removed and all damaged surfaces restored before Final Acceptance.

B. Contractor shall erect temporary closures over openings when weather conditions render such action necessary for proper protection of existing conditions or any portion of the Work.

C. Contractor shall erect temporary closures as required to protect the areas where Owner is occupying during construction. Protection shall extend to the building as well as the occupants.

1.6 TEMPORARY SIGNAGE and DISPLAY

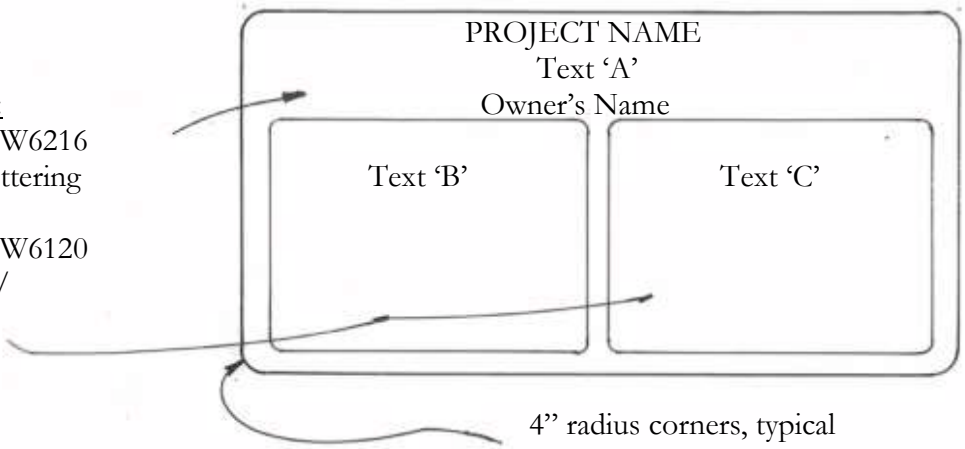
A. No signs will be permitted on this Project except the Project sign, identifying devices over offices, bulletin board and certain directional and warning signs required for safety and protection. Contractor shall take all necessary steps to prevent installation of any unauthorized signs and, should any appear, cause them to be removed immediately, and repair and repaint any damage caused thereby without additional cost to Owner.

B. Contractor shall provide a weatherproof bulletin board, not less than 36" wide and 30" high, with hinged glass door adjacent to or mounted on the Contractor's Project office. If adjacent to the office, the bulletin board shall be securely mounted on not less than 2 posts. Bulletin board and posts shall be painted or have approved factory finish. The bulletin board shall be easily accessible at all times, available for all contractors on the Project for wage rates, equal opportunity notice and other items required to be posted.

C. The Contractor shall maintain the bulletin board in good condition throughout the life of the Project. The bulletin board shall remain the property of the Contractor and upon completion of the Project shall be removed from the site.

D. Within thirty (21) days of Notice of Acceptance, provide and install where directed, Project Sign as shown on following pages. Contractor shall remove Project Sign at completion of the Work. Contractor shall provide shop drawing for review and approval before constructing Project Sign.

E. Project Sign:

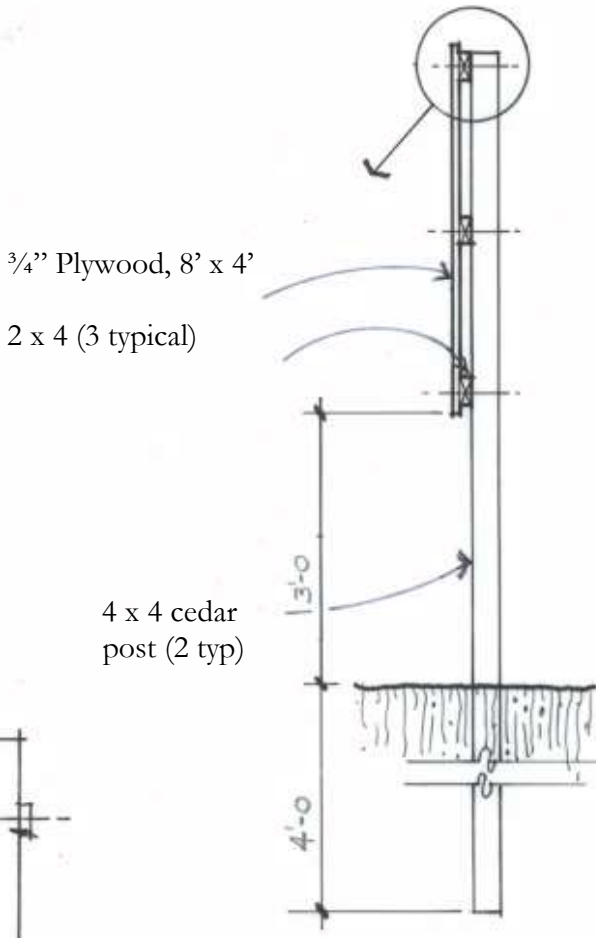


Colors & Lettering:
Sherwin Williams SW6216
'Jasper' w/ white lettering

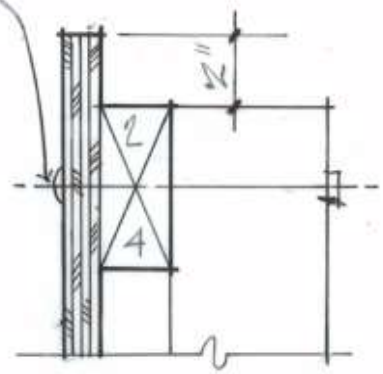
Sherwin Williams SW6120
'Believable Buff' w/
black lettering

General Notes:

1. Lumber to be cut & formed accurately
2. All exposed nails to be set & holes filled with putty.
3. Sign to be set in good solid ground & backfill carefully tamped into place.
4. Where necessary posts shall be braced to provide solid installation.



½" carriage bolts with
2 washers through 5/8"
hole (6 typical)



Text 'A': Line 1: "Chelan County"
Upper & lower case lettering 'GarmdITC Bk BT'
3 ½" lettering height, center justified.

Line 2: "OLDS STATION CAMPUS"
Upper case lettering, w/ lower case word 'GarmdITC Bk BT'
4 ½" letter height, center justified

Line 3: "Wenatchee, Washington"
Upper & lower case lettering, 'Helvetica Medium'
3" lettering height

Text 'B': "**The DOH Associates, PS,** Architects"
Upper & lower case lettering, 'Helvetica Medium/ (Architects) Light'
3" lettering height, left justified

"**Erlandsen** -
Civil Consultant"
Upper & lower case lettering, 'Helvetica Medium/(Structural Consultant) Light'
2 1/2" lettering height, left justified

"**Pacific Engineering & Design, PLLC** -
Structural Consultant"
Upper & lower case lettering, 'Helvetica Medium/(Structural Consultant) Light'
2 1/2" lettering height, left justified

"**Steel Structures America, Inc. –**
Structural Consultant"
Upper & lower case lettering, 'Helvetica Medium/(Electrical Consultant) Light'
2 1/2" lettering height, left justified

"**Kartchner Engineering –**
Mechanical and Electrical Consultant"
Upper & lower case lettering, 'Helvetica Medium/(Electrical Consultant) Light'
2 1/2" lettering height, left justified

Text 'C': (Name) –
General Contractor
Upper & lower case lettering 'Helvetica Medium/Light, 3" left justified.

(Name) -
Mechanical Contractor
Upper & lower case lettering 'Helvetica Medium/Light, 3" left justified.

(Name) -
Electrical Contractor
Upper & lower case lettering 'Helvetica Medium/Light, 3" left justified.

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION 01 50 00

SECTION 01 57 13 – TEMPORARY EROSION and SEDIMENT CONTROL

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTIONS

A. This item shall consist of temporary control measures as shown on the plans or as ordered by the Architect or Engineer during the life of a contract to control pollution of air and water, soil erosion, and siltation through the use of silt fences, berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

B. Temporary erosion control shall be in accordance with the Construction Safety and Phasing Plan (CSPP). The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

C. Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, stockpiling areas, waste areas, and temporary plant sites.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. ASTM International (ASTM)

a. ASTM D6461 *Standard Specification for Silt Fence Materials*

PART 2 – PRODUCT

2.1 MATERIALS

A. Grass Mulch: Not Applicable to this project.

B. Mulches: Not Applicable to this project.

C. Fertilizer: Not Applicable to this project.

D. Slope Drains: Not Applicable to this project.

E. Silt Fence: Silt fence shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life. Silt fence shall meet the requirements of ASTM D6461.

F. Wattles: Fiber wattles shall be made up of weed-free straw with biodegradable netting.

G. Concrete Washout Area: Plastic coverings used to line concrete washout areas shall be seamless to prevent infiltration and be a minimum of 10 mils thick.

2.2 FABRICATIONS

A. Stabilized Construction Entrance: Stabilized construction entrance shall be constructed in general conformance with WSDOT Standard Plan I-80.10-02.

B. Inlet Protection: Inlet Protection materials shall be constructed in general conformance with WSDOT Standard Plan I-40.10-00 and/or I-40.20-00.

PART 3 – EXECUTION

3.1 GENERAL

A. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

3.2 SCHEDULE

A. Prior to the start of construction, the Contractor shall submit schedules in accordance with the approved Construction Safety and Phasing Plan (CSPP) and the plans for accomplishment of temporary and permanent erosion control work for clearing and grubbing; grading; construction; paving; and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the Architect.

3.3 CONSTRUCTION DETAILS

A. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the plans and approved CSPP. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

B. Where erosion may be a problem, schedule and perform clearing and grubbing operations so that grading operations and permanent erosion control features can follow immediately if project conditions permit. Temporary erosion control measures are required if permanent measures cannot immediately follow grading operations. The Architect shall limit the area of clearing and grubbing, excavation, borrow, and

embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current with the accepted schedule. If seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified as directed by the Architect.

C. The Contractor shall provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment as directed by the Architect. If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or directed by the Architect, the work shall be performed by the Contractor and the cost shall be incidental to this item.

D. The Architect may increase or decrease the area of erodible earth material that can be exposed at any time based on an analysis of project conditions.

E. The erosion control features installed by the Contractor shall be maintained by the Contractor during the construction period.

F. Provide temporary structures whenever construction equipment must cross watercourses at frequent intervals. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into any waterways, impoundments or into natural or manmade channels.

3.4 INSTALLATION, MAINTENANCE AND REMOVAL OF SILT FENCE

A. Silt fence shall be constructed in general conformance with WSDOT Standard Plan I-30.5-02. The Contractor shall remove and dispose of silt that accumulates during construction and prior to establishment of permanent erosion control. The fence shall be maintained in good working condition until permanent erosion control is established. Silt fence shall be removed upon approval of the Architect.

3.5 WATTLES

A. Wattles, coir logs, and compost socks used as check dams shall not be trenched in and shall be installed as shown in the Standard Plans. They shall be staked securely with wood stakes every 3 feet along the length to span the width of the ditch and/or completely enclose grates on drainage structures.

3.6 STABILIZED CONSTRUCTION ENTRANCE

A. Install entrance prior to start of construction. The entrance should be maintained in a condition that will prevent tracking or flow of mud onto public rights-of-way. This may require periodic top dressing with additional 2-inch stone (as conditions demand) and repair or cleaning of any structures used to trap sediment.

END OF SECTION 01 57 13

SECTION 01 74 00 – CLEANING

In Addition to the Basic Provisions included in the CONDITIONS OF THE CONTRACT, the following requirements shall be strictly observed.

PART 1 – GENERAL

1.1 SUMMARY

A. Maintain premises and public properties free from unnecessary accumulations of waste, debris, and rubbish caused by operations, through-out the course of the work.

B. At completion of Work, remove waste materials, rubbish, tools, equipment, machinery and surplus materials, and thoroughly clean all areas and surfaces; leave Project clean and ready for occupancy.

1.2 MANUFACTURER'S TRADEMARKS and NAMES

A. The Architect reserves the right to review and request the removal of the manufacturer's trademarks on all materials and equipment which will be in plain view of the occupants of the building when placed in final position. Such removal shall be at no expense to the Owner. A decision on the necessity to remove or redesign may be obtained from the Architect in writing prior to bidding. Failure to obtain such approval shall constitute agreement to comply with such decision at a later date.

1.3 SAFETY REQUIREMENTS

A. Maintain Project in accordance with local City, County, or State applicable Standards and Regulations.

B. Store volatile waste in covered metal containers, and remove from premises daily. Prevent accumulation of waste which create hazardous conditions. Provide adequate ventilation during use of volatile or noxious substances.

C. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

1. Do not bury rubbish and waste materials on Project site.

2. Do not dispose of volatile waste such as mineral spirits, oil, or paint thinner in storm or sanitary drains.

3. Do not dispose of waste into streams or waterways.

PART 2 – PRODUCT

2.1 GENERAL

A. Use only cleaning materials recommended by the manufacturer or surface to be cleaned. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 – EXECUTION

3.1 DURING CONSTRUCTION

A. Maintain building, grounds, and public properties free from accumulations of waste materials and rubbish. Provide on-site containers for collection of waste materials, debris, and rubbish.

B. In addition to dust control provisions specified elsewhere herein, Contractor shall take appropriate steps to prevent airborne dust from soiling or otherwise affecting the work of the Contract. Water shall be applied wherever practical to settle and hold dust to a minimum, particularly during excavation and moving of materials.

C. Wet down dry materials and rubbish to allay dust. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.

D. At reasonable intervals during progress of work, remove waste materials, debris, and rubbish from site and legally dispose of at public or private dumping areas off Owner's property.

E. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted or uncured surfaces.

3.2 FINAL CLEANING

A. Employ appropriately experienced workmen, or professional cleaners, for final cleaning.

B. In preparation for Substantial Completion or occupancy, conduct inspection of all interior and exterior surfaces, and of concealed spaces, in order to determine scope of required cleaning and properly direct cleaning personnel.

C. Remove grease, dust, dirt, stains, labels, fingerprints, paint splatters, and other foreign materials from all visible interior and exterior finished surfaces.

D. Polish glass, fixtures, and hardware, and bright finish specialty items to uniform shine without streaks.

E. Repair, patch, and touch up marred surfaces to match specified finish(s).

F. Thoroughly vacuum all carpeting. Mop/wash all hard surface floors, including smooth troweling or exposed aggregate interior concrete.

G. Apply and buff out 1 coat of approved wax to all resilient flooring (unless flooring is of non-wax type).

H. Strip antimicrobial coating from resilient rubber flooring.

I. Broom clean exterior paved surfaces; rake clean other surfaces of grounds.

J. Remove snow and ice from access to building.

K. Replace HVAC filters and vacuum, clean registers, grilles, ducts, blowers and coils and vacuum if air handling units were operated during construction.

L. Maintain premises in clean condition until Project, or portion thereof, is occupied by Owner.

M. The foregoing provisions shall apply to all areas of new construction, and also to any areas or portions of the existing building(s) and improvements that are in any way affected by the work of this Contract.

END OF SECTION 01 74 00

SECTION 01 78 23 – OPERATING and MAINTENANCE DATA

In Addition to the Basic Provisions included in the CONDITIONS OF THE CONTRACT, the following requirements shall be strictly observed.

PART 1 – GENERAL

1.1 SUMMARY

A. The Contractor shall assemble and provide to the Owner, manuals as described below, containing all normally available technical information on proper operation and/or maintenance of **all** equipment, systems, materials, installations and assemblies that are a part of the Work of this Contract, as well as certain custom drafted instructions/ recommendations where specified in the technical sections of the specifications.

B. The fact that certain items are specifically noted for inclusion in the O & M Manual(s) in the various technical sections of the Specifications shall not be construed as reason for exclusion of customarily available information from the manual(s). **If instructions or recommendations exist, they shall be included.**

C. Separate manuals may be made up for the General, Mechanical and Electrical portions of the Work. Refer also to General Requirements of DIVISIONS 21, 22, 23, and 26.

1.2 REQUIRED PROCEDURE

A. Submittals of O & M Manuals not strictly conforming to the requirements of this Section will be returned forthwith for proper resubmittal, resultant delay in approval being the responsibility of the Contractor.

1. Prior to request for Pre-Final inspection, submit preliminary draft copies to Architect for approval before making up final copies. Upon approval and **prior to Owner Instruction Session(s)**, submit 2 final copies (of each manual) and 1 electronic copy to Architect for transmittal to Owner.

1.3 FORMAT

A. Manuals shall be made up in 8-1/2" x 11", (nominal) standard 3-ring binders of good quality, labeled **on the spine** with title, job name and date. All contents shall be 8-1/2" x 11" sheets, except that drawings may be neatly accordion folded to 8-1/2" x 11" size and punched for insertion, with drawing identification clearly visible in lower righthand corner of top side of fold. All data in manuals must be clean, neat, clearly readable, and organized by Specification Division, or other logical sequence, with heavy manila tabbed dividers.

B. An electronic copy of the manual shall also be submitted using the same organization, material and indexing as the hard copies.

1.4 CONTENTS

A. Manuals shall include at least the following:

1. Neatly typewritten index near the front of the manual, furnishing immediate information as to location in the manual of all emergency data regarding the installation. (i.e., phone number of emergency service, etc.).

2. Complete **custom drafted** instructions for proper operation and maintenance of jobsite integrated systems of configuration unique to this project, as called for in the various technical sections of the specifications (this will normally include HVAC systems, irrigation systems, etc.).

3. Complete instructions regarding operation and/or maintenance of all items of equipment, devices, assemblies, manufactured systems, materials and finishes incorporated into the Work.

    a. Include all assembly instructions and other related packing materials shipped with individual equipment and fixtures and used for installation of the product.

4. Complete nomenclature of all replaceable parts of all equipment, devices or assemblies, their part numbers, current cost, and name and address of nearest vendor of parts.

5. Copies of all guarantees and warranties called for and issued. These copies are in addition to those initially required for approval. Each guarantee, or attachment thereto, shall clearly state the date the guarantee warranty) starts and the name, address and telephone number of the guarantor's representative nearest the Project who will, upon request from the Owner, honor the guarantee (warranty) and provide services prescribed therein.

6. Copies of the related **approved** Shop Drawings (Layout Drawings, etc.) with all data concerning changes made during construction, as applicable, for all items in the manual.

B. Where manufacturer's catalog pages are included in the manual(s), clearly indicate the precise items included in this installation and delete, or otherwise clearly indicate, all data with which this installation is not concerned.

1.4 OWNER INSTRUCTION SESSION

A. Upon completion of the Work of Contract, delivery of O & M manuals, and **prior to certification of Substantial Completion,** the Contractor and/or authorized subcontractors shall, **using the O & M manuals as a reference**, thoroughly instruct the Owner, or his authorized representative, in the proper operation and maintenance of all, systems, equipment, assemblies, materials and finishes installed under this Contract.

B. Liability for damage to equipment, systems, or materials caused by improper operation and/or maintenance by the Owner due to lack of proper information and instruction from the Contractor, shall accrue to the Contractor.

C. Time and date of Instruction Session(s) shall be as mutually agreeable to the Owner and the Contractor.

D. Separate sessions may be held for General, Mechanical, and Electrical portions of the Work, **but all components of each of these three categories shall be covered in a single integrated session** (i.e., HVAC controls shall not be discussed separately from basic HVAC system operation, etc.).

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION 01 78 23

SECTION 01 78 39 – PROJECT RECORD DOCUMENTS

In Addition to the Basic Provisions included in the CONDITIONS OF THE CONTRACT, the following requirements shall be strictly observed.

PART 1 – GENERAL

1.1 SUMMARY

A. Complete Record Documents, maintained and submitted as herein described are a mandatory part of the construction process under this Contract. The Architect will review the Record Documents each month prior to certifying the Contractor's Request for Payment, and **no partial payment for any part of the Work will be authorized unless record documentation applicable to that portion of the Work is current and accurate to date.** Likewise, the Work will not be considered complete until the final submittal copies of the Record Documents, as hereinafter described, are properly completed, returned to the Architect, and accepted as complete.

B. In addition to the basic provisions of the General Conditions, the following requirements shall be strictly reserved

1.2 MAINTENANCE OF JOBSITE DOCUMENTS

A. Maintain in current state, at the job site, 1 copy of the following:

1. Contract Documents
2. Specifications
3. Addenda
4. Reviewed Shop Drawings
5. Change Orders
6. Other Modifications to the Contract
7. Field Test Reports
8. Progress Reports
9. Updated Construction Schedule

B. Label each Document “Project Record” in 2 inch high printed lettering.

C. Record Documents shall be kept up-to-date daily during the entire course of the Work and shall be available on request for examination by the Architect, and when necessary, to establish clearances for other parts of the Work.

D. Use colored pencils for marking, conforming to the following color code:

1. Red for architectural work
2. Dark Green for structural work
3. Dark Blue for plumbing work

4. Purple for heating, ventilating, and air conditioning work
5. Orange for electrical work

E. Store documents in temporary field office, apart from documents used for construction. Maintain documents in clean, dry, legible condition. Do not use Project Record Documents for construction purposes. Documents shall be available at all times for inspection by Architect/Engineer and Owner.

F. The following information shall be maintained on the Record Drawings:

1. All changes or deviation from sizes, locations, details, items, or other features of installation as shown in the original Contract Documents shall be recorded whether covered by Change Order, Field Order, or affected by Contractor's option.

2. In addition, it shall be possible, using these drawings, to correctly and easily locate, identify and establish sizes of utilities, all piping, ductwork and the like, as well as all other features of work **which will be concealed**, either underground and/or in enclosed spaces.

3. Locations of underground work shall be established by dimensions to permanent monuments, control points, or improvements, and by properly referenced centerlines or invert elevations and rates of fall. Show all changes in direction or slope, points of intercept, access, boxes, cleanouts, etc.

4. For work concealed in the building, sufficient information shall be given so it can be located with reasonable accuracy and ease. Ordinarily, this shall be by exact scale, or dimension.

G. The following information shall be maintained in the Record Specifications and Addenda:

1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.

2. Changes or approvals of specified items, standards or procedures made by Change Order.

3. Other incorporated items, standards or procedures not originally specified.

1.3 FINAL SUBMITTAL COPIES

A. As the Work nears completion, the Architect will provide, (1) complete set of the original (Bidding) Drawings in AutoCAD Format, (1) electronic or reproducible copy of any change order, revision or clarification drawings larger than 8-1/2 x 11 issued during the course of the Work, and (1) complete set each of Specifications, Addenda and 8-1/2 x 11 change order, revision or clarification drawings.

B. Working from the jobsite Record Documents, and any other supporting data required, and utilizing a competent draftsman, the Contractor shall carefully and neatly record, throughout each of the Documents described in the foregoing paragraph, all changes,

notations and other information stipulated hereinbefore to be recorded. Drawings shall be in AutoCAD form and format, plotted at full size, bound and provided in both hard copy and electronic form back to the Owner and shall be as approved by the Architect.

C. Changes/deviations in locations or dimension illustrated on the electronic drawings shall be by means of erasure and redrafting to accurate scale, EXCEPT in the case of very minor differences which may be indicated by dimension only, NTS. The Contractor may provide additional drawings for clarification if required, however, no drawing size shall exceed the typical sheet size of the original (Bidding) Drawings. Specifications shall be in hardcopy with all changes hand noted.

D. Prior to request for Final Acceptance Inspection, submit one complete set of Record Documents to Architect for review and comment. Upon receipt of Architect's comments and prior to submitting request for final payment, resubmit (finally corrected) documents, including the reproducible set plus 1 set of Drawings and the marked copies of all other Documents.

E. This Final Record Contract Documents submittal shall be accompanied by a transmittal letter which contains:

1. Date of submittal
2. Project title and number
3. Contractor's name and address
4. Title and number of each Record Document
5. Statement of certification that each document as submitted is complete and accurate
6. Signature of Contractor, (authorized representative).

PART 2 – PRODUCT

(Not Used)

PART 3 – EXECUTION

(Not Used)

END OF SECTION 01 78 39

SECTION 03 20 00 – CONCRETE REINFORCING

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 STANDARDS

A. Comply with requirements set forth in ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures", except where more exacting requirements are specified in the Contract Documents.

B. Bars shall be bent cold and details of reinforcement shall conform to ACI 318-14, Chapter 25. Welding of reinforcing steel shall be by certified welders in conformance with details on Drawings and with the American Welding Society's Recommendations for Welding Reinforcing Steel (A.W.S. D1.4, latest edition).

C. Abbreviations Used in This Section

1. ACI:American Concrete Institute, 38800 County Club Drive, Farmington Hills, Michigan 48331.

2. ASTM:American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania, 19102.

3. CRSI:Concrete Reinforcing Steel Institute, 38 S. Dearborn Street, Chicago, Illinois, 60603.

1.2 SUBMITTALS

A. Submit drawings to Architect showing bending and placing of all reinforcing. Drawings shall include diagrammatic elevations of all walls at a scale sufficiently large to show clearly the position and erection marks of marginal bars and their dowels and splices. Review shall extend only to general arrangement and correspondence with the Drawings and Specifications and shall not relieve the Contractor from complying with the requirements of the Contract Documents as to dimensions, laps, lengths, fit and all other details. Do no fabrication before receipt of reviewed drawings from the Architect. See Section 03300 for additional reinforcement and design requirements.

1.3 STORAGE

A. Pile reinforcement at the site to prevent excessive rusting or fouling with grease and/or coating that will interfere with bond. Store so as to maintain identifications after bundles are broken.

1.4 COORDINATION

A. Coordinate work with other trades so as not to interfere with their work. Bring interferences between trades to Architect's attention and resolve before any concrete is poured.

1.5 SPECIAL INSPECTION and TESTING

A. Refer to Section 01 45 00 and structural drawings for additional information and requirements.

PART 2 – PRODUCT

2.1 MATERIALS

A. Reinforcing Bars: Shall be deformed bars conforming to ASTM, A615, (S1), Grade 60, unless otherwise noted. Each bundle shall be accompanied by identification of heat number and grade.

B. Welded Wire Fabric: Shall conform to requirements of ASTM, A1064, furnished in flat sheets. Gauges and dimensions shall be as noted on the Drawings. Provide in all interior slabs where bars are not indicated, and exterior slabs on grade unless noted otherwise.

C. Dowel Bars: shall be plain steel bars conforming to ASTM A 615, ASTM A 616, or ASTM A 617 and shall be free from burring or other deformation restricting slippage in the concrete. High strength dowel bars shall conform to ASTM A 714, Class 2, Type S, Grade I, II, or III, bare finish. Before delivery to the construction site each dowel bar shall be painted on all surfaces with one coat of paint meeting Federal Specification TT-P.

D. Accessories: Conform to CRSI, "Manual of Standard Practice for Reinforced Concrete Construction". Include all devices necessary for proper placing, spacing, supporting and fastening steel reinforcement in place. Metal or plastic accessories, except where noted otherwise. Colored concrete block chairs and spacers only at architectural exposed concrete. Use concrete blocks or metal chairs to support reinforcement in slabs.

E. Non-Shrink Grout: Masters Builders 'Masterflow 928', or approved.

PART 3 – EXECUTION

3.1 INSTALLATION

A. All reinforcing steel shall be detailed in conformance with ACI "Manual of Standard Practice For Detailing Reinforced Concrete", except as otherwise shown.

B. Placing: Reinforcement shall be accurately placed in accordance with Structural Drawings and reviewed shop drawings and securely tied at intersections with 16-gauge black annealed wire. It shall be maintained in proper position by chairs, bar supports, or other approved devices. Bars in footings shall be supported on precast concrete blocks. Support securely so that bars may be walked upon without displacement and fasten to prevent movement before and during placing of concrete.

1. Bars shall be free from loose, flaky rust, mud, mill scale, oil or other coating that will reduce bond.

C. Laps and Splices: Bars shall lap 45 diameters, or 24" minimum, unless otherwise indicated on Drawings. Splices in adjoining horizontal bars shall be staggered at least 6 feet. Where this is not feasible, submit suggestions for the Architect's consideration. Horizontal bars shall be hooked around corners not less than 30 diameters, or a minimum of 24", unless otherwise shown on Drawings.

1. Lap wire fabric a minimum of one full mesh on sides and ends, but not less than 8".

2. Wherever conduit, piping, inserts, sleeves and other embedded items interfere with the placing of reinforcing steel as shown or called for, the Contractor shall consult the Architect and secure from him in writing the method of procedure before pouring any concrete. Bending or field cutting of bars around openings or sleeves will not be permitted.

D. Bends shall generally be made prior to placement. No bars partially embedded in hardened concrete shall be field bent unless specifically so detailed or approved.

E. Concrete cover of bars shall conform to ACI requirements as a minimum and as may otherwise be detailed or noted on the drawings.

F. Welding: Shall be done by welders certified by a third party quality control agency, such as Washington Association of Building Officials (WABO). Conform to requirements of the American Welding Society Standard Code of Arc and Gas Welding in Building Construction.

G. Non-shrink grout shall be mixed and placed in strict accordance with manufacturers' printed instructions.

H. Inspection: Contractor's job superintendent shall personally inspect placement of all reinforcing steel to ensure proper installation, in accordance with Design Drawings and reviewed shop drawings. He shall sign a daily log and note in his Progress Report his approval prior to pouring of concrete.

END OF SECTION 03 20 00

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SCOPE

1.2 The Extent of concrete work, excluding incidental patching, is shown on the Drawings.

1.3 STANDARDS

A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified:

1. ACI 315"Manual of Standard Practice for Detailing Reinforced Concrete Structures"
2. ACI 318"Building Code Requirements for Reinforced Concrete"
3. ACI 347"Recommended Practice for Concrete Formwork"
4. ACI 304"Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete"
5. ACI 605"Recommended Practice for Hot Weather Concrete"
6. ACI 306"Recommended Practice for Cold Weather Concrete"

1.4 SUBMITTALS

A. Submit mix design for approval, substantiated by test results for the various strengths and types of concrete required. Obtain Architect's acceptance of mix before delivery of material to job.

1.5 QUALITY ASSURANCE

A. Workmanship: The workmanship must be equal to the best practice in modern construction. Contractor shall exercise the greatest possible care to make a uniform dense concrete of required strength, true to elevations and lines shown on the Drawings.

1. All concrete work which does not conform to the specified requirements, including strength, tolerances, finishes, or due to excessive imperfections shall be corrected or removed and recast as directed by the Architect at the Contractor's expense without time extension therefore. The Contractor shall also be responsible for the cost of corrections to any other work affected by, or resulting from, corrections to the concrete work.

B. Concrete Sampling and Testing: Materials and installed work will require testing and retesting by the (Owner's) inspection laboratory as required by the IBC. Refer to Section 01 45 00 and structural drawings for additional information and requirements.

C. Specimens will be taken by testing laboratory/special inspector. Contractor shall provide labor, and material as required, to assist testing laboratory in preparing specimens for testing, and job storage facilities for making and storage of specimens. Assist in packing specimens for shipping.

1. Delivery of specimens will be done by testing laboratory/special inspector.

2. The Testing Laboratory may:

   a. Make and cure concrete test specimens for each strength of concrete in accordance with ASTM C31. Make not less than one set of three identical compression test specimens from concrete obtained from each one hundred (100) cubic yards or fraction thereof placed each day.
   b. Make slump tests in accordance with ASTM C143 to control slump. Make one test for each batch of each strength of concrete and at least one test per hour during a continuous concrete pour.
   c. Make air entrainment tests in accordance with ASTM C173 for each batch of each strength of concrete.
   d. Keep an identification record of cylinders taken and concrete poured. Mark all cylinders from each set with the same number on one end and enter this number in a record book for this purpose with the date, time and location in the Building.
   e. Make compression tests in accordance with ASTM C39. Where Type I cement is used, test one cylinder at 7 days and one cylinder at 28 days. Where Type III cement is used, test one cylinder at 3 days and one cylinder at 7 days. The third cylinder shall used as a check cylinder when required. If report is satisfactory, dispose of third sample; if report is unsatisfactory, test third sample at age selected by Architect.
   f. Assume full responsibility for transportation of test specimens from job site to laboratory. Submit test reports to the Architect.

D. Evaluation of tests shall proceed promptly so as not to impede progress of the Work. Strengths of concrete shall be considered satisfactory if the average of any three consecutive strength tests of the laboratory cured specimens representing each specified strength of concrete is 15% greater than the specified strength, and if not more than 10% of the strength tests have values not more than 10% less than the specified strength.

   1. If strength tests fail to meet the minimum requirements, the concrete represented by such tests shall be considered questionable and shall be subject to further testing. Refer to Section 01 45 00.

   2. The Architect may require test cores of hardened structure to be taken by the testing laboratory in accordance with ASTM C42 and C39. If test indicates core specimen below required strength, remove the concrete in question and replace it without cost to the Owner.

1.6 COORDINATION

A. Schedule the work and notify other trades in ample time so that provisions for their work can be made without delaying progress of the Project. Any patching or cutting made necessary by failure or delay in complying with this requirement shall be at the Contractor's expense.

PART 2 – PRODUCT

2.1 MATERIALS

A. Form Materials: Unless specified or detailed otherwise, construct all formwork with new plywood or clean steel forms, to provide continuous straight, smooth, exposed surfaces. Vertical surfaces not over 12" high may be formed with new dimension lumber or stock steel forms. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.

B. Form Ties: Adjustable length removable or snap-off metal ties (with plastic cone heads) designed to prevent spalling of concrete during removal (and to receive pre-cast concrete plugs as specified). Any portion of ties remaining in wall after removal shall be at least 1-1/2" below formed concrete surface.

C. Reinforcing Materials: See Section 03 20 00.

D. Concrete Materials:

1. Cement shall conform to "Specifications for Portland Cement", ASTM C150, Type I or II.

2. Aggregate shall conform to ASTM C33, except as modified herein. Aggregates shall be uncoated, clean and thoroughly washed before using and shall not contain disintegrated granite, shale or decomposed laminated pieces.

3. Fine aggregate shall be concrete sand, as available from established, approved local sources.

4. Maximum size of aggregate shall be 1-1/2" for standard weight concrete, but not larger than 1/5 of the depth of slabs or 3/4 of the minimum clear distance between reinforcing bars and forms.

5. Water shall be clean and free from oil, acid, alkali, vegetable matter, organic matter and other deleterious substances.

6. Water Reducing Agent(s) (Plasticizers): Sika 'Plastiment' or Master Builders' 'Pozzolith'.

7. Air-entraining admixture shall be per ASTM C260.

E. Related Materials:

1. Joint Filler Strips: 'Ceramar' by W.R. Meadows, or approved, 3/8" thickness x 3" deep, or as otherwise detailed or noted.

2. Liquid Joint Sealer: 'Master Seal SL2' paving joint sealant, or approved.

3. Membrane forming curing compound, if and where allowed, shall conform to ASTM C309, Type 1. Dayton Superior Clear Cure VOC J7WB dissipating sealer.

4. Non-Shrink: Grout: Master Builders 'Masterflow 928', or approved.

2.2 CONCRETE FORMWORK

A. Forms: Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.

1. Formwork shall be designed to be readily removable without impact, shock or damage to concrete surfaces and adjacent materials and surfaces.

2. Forms shall be in compliance with ACI 347 construct to sizes, shapes, lines and dimensions shown and to obtain accurate alignment, location, grades, level and plumb work in the finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features as shown or required in the Work. Solidly butt joints of forms and provide back-up at joints to prevent leakage of water and/or cement paste. Use vinyl foam tape at joints of formwork for all architecturally exposed concrete. Voids, honeycombing, sand pockets, fins, etc., may be cause for rejection.

3. Fabricate forms for easy removal without hammering or prying against the concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.

4. Provide temporary openings where formwork is inaccessible for cleanout, for inspection before concrete placement by Architect/Project Engineer or Special Inspector, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of water or cement paste. Locate temporary openings on forms at inconspicuous locations as approved.

B. Cleaning and Tightening: Before inspection of forms and reinforcing steel thoroughly clean forms and adjacent surfaces to receive concrete. Remove wood chips, sawdust or other debris just before concrete is placed. Retighten forms after placement of concrete, and as required, to eliminate any concrete or water leakage.

C. Form for exterior slabs, walks, and steps to finish elevations indicated on Drawings and as otherwise required to provide positive drainage away from building(s) and off concrete surfaces.

1. Where not otherwise indicated, typical drainage slope shall be 1/4" per foot.

2.3 REINFORCEMENT INSTALLATION

A. See Section 03 20 00.

2.4 PROPORTIONING and DESIGN of MIXES

A. See structural drawings for required concrete mix designs, maximum slump, water/cement ratio, air, and minimum sacks per cubic yard.

B. Submit mix design for approval, substantiated by test results for the various strengths and types of concrete required. Obtain Architect's approval of mix before delivery of material to job.

C. Air-entrained concrete shall be in strict accordance with agent manufacturer's printed instructions and shall be limited to the following:

1. For concrete slabs (pavement)/walks exposed to weather, use 6.5% of entrained air, by volume, as determined by procedure prescribed in ASTM C231.

2. For other concrete exposed to weather, use 4% of entrained air, by volume, per ASTM C231.

3. For concrete at all other locations, use of air-entraining agents not permitted, except where approved by the Architect.

PART 3 – EXECUTION

3.1 CONCRETE MIXING

A. Mixing Concrete: Consistency of mix shall be obtained with the minimum amount of water required to produce a concrete that will flow sluggishly into the forms, work properly into the corners, angles, and reinforcement without excessive puddling, spading or vibrations and without permitting the materials to segregate or free water to collect on the surface.

B. Maximum slump of all concrete measured in accordance with ASTM C143 shall be as follows: All slabs on grade: 2" for concrete which has plasticizer additive added (prior to addition of plasticizer); 3" for other slabs where no plasticizer additive is added; all other concrete, 4".

C. Ready-mixed concrete shall be used in accordance with the Specifications and ASTM C-94. Discharge and place concrete not later than one hour after the addition of water. Mix concrete for a minimum of 10 minutes, at least 3 minutes of which must be immediately prior to discharge at the site. No additional water to be added at the site.

3.2 CONVEYING and PLACING CONCRETE

A. Do not place concrete until the forms and reinforcement have been completed and all preparations for the pour have been made, and have been inspected and approved by the Architect or his authorized representative.

B. Notify Architect (and Special Inspector) not less than 48 hours before placing concrete.

C. Clean formwork thoroughly, removing all loose dirt, scrap lumber and other debris from forms and footing trenches before pouring.

D. In no case shall concrete be placed on standing water, muddy, soft or spongy areas. Subgrade conditions shall conform in all respects to requirements of Section on 'Earthwork' hereinbefore.

E. Pours of concrete once started, shall be carried on as a continuous operation until the section of approved size and shape is completed.

F. Depositing of concrete shall be continuous, or in layers, or bands, of such thickness that no concrete will be deposited on, or against, concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section.

G. Vibration shall follow immediately upon deposit so as to minimize entrapped air between concrete and form and to blend two layers.

H. Slabs: Before placing slabs, removable screed shall have been installed at edges of walls and at as many intermediate locations as necessary to ensure correct elevations and true planes. Surfaces shall be defined by fair lines and be free from irregularities.

1. Place concrete on damp (not wet) firm earth, or drainage fill where so indicated on Drawings. Rod to uniform surface true to plane within 1/4" in 10' in any direction.

2. Form slabs with control joints conforming to details on Drawings. Install joint filler strips, as detailed, wherever slabs abut vertical surfaces, and at all construction and control joints in exterior slabs and exposed interior slabs on grade. Control joints in exterior slabs are not to be more than 12'-0" o.c. in any dimension, and at exposed interior slabs not more than 16'-0" in any dimension, in any case, unless specifically dimensioned otherwise on Plans. Refer to details on Drawings for finish tooling pattern of joints in exposed exterior slabs.

3. All (interior) slabs shall be poured in alternating (formed) sections or control joints shall be saw-cut within **8 hours** of the pour with a "green concrete" saw blade. Cutting times may be extended 4 hours when ambient temperatures are below 60°s.

4. Where Drawings call for sealing compound finish at exposed control joints, joint filler material shall be installed with depth as required to bring top to 3/4" below surface of slab. Fill remainder of joint with standard sealing compound, "Sonelastic" Paving Joint Sealant or approved.

5. Prepare slabs for finishing by tamping concrete with special tools to force the coarse aggregate away from the surface and then screed to the required level.

I. Stained Concrete Floors: Before concrete is placed in areas to be stained, all parties involved, including the architect are to meet on site to review placing, finishing, and staining concrete.

J. Cold Weather: When the mean daily temperature of the atmosphere is less than 50 degrees F., the contractor shall institute cold weather concreting precautions and practices in accordance with ACI standard recommended practice for winter concreting ACI 604 (306). Admixtures shall be used in all concrete to reduce the mixing water requirements and to control the rate of hardening in keeping with specifications

requirements and prevailing job site temperatures. Exterior walks shall not be poured in freezing weather and shall be maintained at a surrounding air temperature of 40 degrees for a period of 28 days. No additional time will be given for delays to concrete placement due to ambient air temperatures or snow cover.

K. Hot Weather: Arrangements for installation of windbreaks, shading, fog spraying, sprinkling, ponding or wet covering of a light color shall be made in advance of placement, and such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow.

L. Changes in Temperature: Curing temperature of all concrete shall be as uniform as possible. Changes shall not exceed 5 degrees F. in any one hour or 50 degrees F. in any 24-hour period.

3.3 PROTECTION and CURING

A. Leave forms in place not less than the period specified herein (7 days following the pour) for curing, unless adequate provision is made to keep the surfaces of the concrete wet, or to prevent evaporation by application of a suitable, approved, membrane.

1. Concrete shall be protected from damage during removal of formwork and from injury resulting from the storage or movement of materials during construction.

B. Cure concrete by keeping in a thoroughly moist condition by hot mist, saturated water cure blanket covering or other approved means, from the time it is placed until it has cured for not less than 7 days for Type I and II cement concrete and 3 days for Type III cement. Cure for longer periods if the Architect so directs.

1. Fluid (spray) applied curing compounds are generally not a preferred curing method and, even if allowed, Contractor shall accept all responsibility for any resultant problems of unsatisfactory curing, surface residue, improper adhesion of finished coverings, etc.

2. On exterior slabs apply fluid applied curing compounds per manufacturer's written instructions.

3. When forms are removed prior to end of prescribed curing time, continue curing for the prescribed time as specified above.

3.4 SLAB FINISHES

A. Smooth trowel finish shall be provided at all interior slab surfaces, unless specifically noted or scheduled otherwise. Trowel by hand or machine to hard, dense surfaces, free from trowel marks. Do not absorb wet spots with neat cement or mixture of sand and cement. Wait until surfaces are dry enough for proper troweling. Chemical dryers not permitted. Trowel to uniform surface, true to plane, as indicated: tolerance 3/16" in 10' in any direction. Testing of surfaces shall occur 72 hours after slab installation and shall be performed by the Contractor.

B. At exterior slabs and walks, not otherwise noted, lightly brush wet troweled surface with soft hair broom, all strokes perpendicular to walks or flow lines, or in direction as indicated on Drawings, to create moderately abrasive, uniform, non-skid surface. Where called for on Drawings, "smooth trowel" finish at exterior slabs and walks shall be "sweat" finish (not hard troweled) as approved.

1. Mark off slabs as indicated or directed; round edges to 1/2" radius with 1-1/2" wide smooth edging tool. Unless otherwise indicated or detailed, edge all sections of brushed slabs with 1-1/2" wide smooth edging along all edges and both sides of all joints.

3.5 FINISHES OF FORMED SURFACES

A. Standard Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work or covered by other construction, unless otherwise shown or specified. Concrete surface may retain the texture imparted by the form facing material used, with significantly defective areas repaired and patched as specified. Form tie holes to be filled flush with formed concrete surface with cement grout.

B. Standard Smooth Finish: For formed concrete surfaces exposed to view, or that are to be covered with a coating material applied directly to the concrete or a covering material bonded to the concrete such as waterproofing, dampproofing, painting or other similar system, provide as-cast concrete surface as obtained with the form facing material, with defective areas repaired and patched as specified, and fins and other projections on the surface completely removed and smoothed. Form tie holes to be filled and finished flush with formed concrete surface with cement grout.

C. For Exposed Concrete: The formed surface shall be similar to standard smooth finish surface. Repair and patch tie holes, honeycombs and defective areas to a smooth finish. Remove fins and other projections completely and smoothed. Thoroughly wet surface and provide a sacked finish by coating the entire exposed concrete surface with sacking mortar as soon as the concrete surface approaches dryness. Thoroughly and vigorously rub mortar over the area with clean burlap pads to fill all voids. While mortar is still plastic but partially set (so it cannot be pulled from voids), sack-rub surface with dry mix of sacking mortar (leave out water). There should be no discernible thickness of mortar on concrete surface, except in voids; all surfaces should be uniformly textured. Immediately begin a continuous moist cure for 72 hours.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strikeoff smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown.

E. Miscellaneous Finish Patching: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete the work.

3.6 CONCRETE SURFACE REPAIRS

A. Repair and patch defective areas with cement mortar immediately after removal of forms, but only as acceptable to the Architect/Engineer. Surface defects, as such, include color and texture irregularities, cracks, spawls, air bubbles, honeycomb, rock pockets and holes left by tie rods and bolts; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning.

1. Cut out honeycomb, rock pockets, voids over 1/2" diameter and holes left by tie rods and bolts, down to solid concrete, but in no case, to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Before placing cement mortar, thoroughly clean, dampen with water and brush-coat the area as acceptable to Architect.

2. For surfaces exposed to view, blend white Portland cement and standard Portland cement so that when dry, patching mortar will match color of surrounding surfaces. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

B. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect/Engineer.

C. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having required slope. Replace such slabs, etc., which cannot be repaired satisfactorily and approved by Architect.

D. Repair finished unformed surfaces that contain defects which adversely affect durability of concrete. Surface defects include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets and other objectionable conditions.

E. Correct high areas in unformed surfaces by grinding, if approved by Architect, after concrete has cured at least 14 days.

F. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out low areas to the nearest joint or edge on all sides and replacing with fresh concrete. Finish repaired areas to match adjacent concrete.

G. All concrete slabs shall be tested with a straight edge in the presence of the Architect/Engineer prior to construction of walls, etc which would preclude removal and replacement of new concrete slabs. All high areas and low areas shall be repaired prior to acceptance and beginning of adjacent work.

END OF SECTION 03 30 00

SECTION 05 50 00 – METAL FABRICATIONS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Requirements of this Section apply to all custom fabricated metal assemblies and components, and any modifications to specified stock assemblies or components unless specifically superseded by the manufacturer's standards. These requirements may be cross-referenced from other sections of the specifications, e.g., cabinets/casework, baggage handling system, etc.

1.2 SUBMITTALS

A. Per Division 1 and GENERAL CONDITIONS, submit the following within 30 days of award of Contract:

1. Shop Drawings showing complete details of construction, including locations, marking, quantities, materials, sizes and shapes; and indicate all methods of connecting anchoring, fastening, bracing and attaching to work of other trades, for all items in this Section.

2. Where welded connectors, concrete or masonry inserts, are required to receive work, show size and locations required.

1.3 QUALITY ASSURANCE

A. In addition to complying with all pertinent codes and regulations, comply with the following:

1. "Design, Fabrication and Erection of Structural Steel for Building" AISC, 9th edition.

2. American Society for Testing and Materials, latest edition (ASTM).

3. American Welding Society's "Code for Welding in Building Construction" D1.1, latest edition (AWS).

B. In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards, the provisions of the more stringent shall govern.

1.4 DELIVERY, HANDLING and STORAGE

A. Deliver and store materials to keep out of inclement weather, dust and mud. Keep materials free from corrosion.

B. Use all means necessary to protect miscellaneous metal before, during and after installation and to protect the installed work and materials of all trades.

PART 2 – PRODUCT

2.1 GENERAL

A. Metal for all fabrications shall be steel, as specified, except where specified or noted.

B. All steel pieces exposed to weather, including items embedded in concrete with less than 1" cover at any point, shall be hot zinc galvanized after fabrication, unless otherwise specified or noted.

2.2 MATERIALS

A. Bollards: Schedule 40 steel pipe of the size noted on the drawings.

B. Stainless Steel Sheet or Plate: Type 304, or as approved for specific application. 16 gauge on vertical surfaces, 14 gauge on horizontal and angled surfaces, except as otherwise noted on the drawings or specified below.

C. Stainless Steel Shapes: Type 304 (18-8) rolled angles or channels. Julius Blum & Co., or equal. AISI #4 finish except as otherwise specified or below or noted on the drawings.

D. Steel Plates, Shapes, Angles and Rods: ASTM A36 Steel.

E. Structural Tubing (sq, or Rect.): ASTM A500-C Steel.

F. Pipe: ASTM A53-B, Type E or S.

G. Pipe Handrail Brackets: Julius Blum #622 or approved equal.

H. Fastenings: Supply all angles, bolts, plates, lags, anchors, and other items to support properly, and secure all items furnished in this Section.

1. All bolts in common bolted connections shall be ASTM F3125 Grade bolts. For bolts to other materials, not steel-to-steel, use A307 bolts with lock washers; sizes and types as indicated on drawings.

I. Expansion Bolts: (See structural notes on Drawings.) Phillips Drill Co., "Red Head" wedge anchors, or approved equal.

J. Aluminum Shapes, Tubes, etc.: 6061-T52 alloy, by Julius Blum, or equal. All aluminum shall be anodized. Color as selected.

K. Other Materials: All other materials not specifically described, but required for complete and proper installation of metal fabrications as detailed and specified herein, shall be new, free from rust, staining or corrosion, best quality of their respective kinds, and subject to the prior approval of the Architect prior to fabrication.

2.3 SCHEDULE OF CERTAIN METAL FABRICATIONS

A. Metal fabrications shall include, but not be limited to, the following items:

1. Pipe Handrails/Guardrails: Fabricate of steel pipe with all welded connections. (standard mechanical connections). Hot dip galvanized after fabrication for exterior locations. Standard weight Schedule 40 mild steel pipe, 1-1/2" diameter, (1.9" o.d.) unless noted otherwise on Drawings. Utilize standard commercially manufactured pipe rail elbow fittings of radii as indicated.

2. Bollards: Schedule 40 steel pipe of the size noted on the drawings.

3. Miscellaneous Brackets, Hangers, Supports, etc.: Fabricate from standard shape as detailed and/or required. Prime for paint all interior items. All exterior items to be galvanized.

4. Other Materials: All other materials not specifically described, but required for complete and proper installation of metal fabrications as detailed and specified herein, shall be new, free from rust, staining or corrosion, best quality of their respective kinds, and subject to the prior approval of the Architect prior to fabrication.

PART 3 – EXECUTION

3.1 INSPECTION

A. Prior to fabrication or installation of any work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where installation of the work of this Section may properly commence.

B. Make all required measurements in the field to ensure proper and adequate fit of miscellaneous metal items. Verify that miscellaneous metal may be fabricated and installed in strict accordance with the original design, the reviewed shop drawings, and codes and regulations.

C. In the event of discrepancy, immediately notify the Architect. Do not proceed with fabrication or installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 FABRICATION

A. Form to accurate sizes and shapes, with true lines and angles. Punch and shear to leave clean surfaces. Weld or rivet permanent connections as detailed or noted and in conformance with best trade practice, grind exposed welds and edges smooth. Do not use screws or bolts where they can be avoided. When used, countersink heads and draw up tight; nick threads to prevent loosening. Provide holes and connections required for work of other trades.

B. Detail joints and fastenings for ample strength and stiffness; conceal wherever possible. Where exposed at exterior, form joints for weather resistance.

C. All welding of steel shall conform to requirements set forth in 05100. Welding of other metals shall conform to applicable American Welding Society standards and best trade practices.

D. Shop Treatment: After fabrication, remove rust scale, grease and oil by wire brushing and chemical cleaning. Touch up galvanized metal surfaces damaged in fabrication with "Galv-weld", "Galvicon", or approved. Coat other metal with one heavy coat, approved metal primer compatible with paint item is scheduled to receive. Non-galvanized steel shall be primed in accordance with the Steel Structures Painting Council Specification 15-68T, Type 1 (red oxide).

3.3 INSTALLATION

A. Coordinate installation schedule with the schedules other trades to ensure orderly and timely progress of the total work.

B. Erect and install all framing and miscellaneous metal items in strict accordance with the Drawings, the reviewed shop drawings, and the referenced standards, aligning straight, plumb, and level within a tolerance of 1 in 200. Provide blocking wherever required for proper installation of other items.

C. Install expansion bolts, HS bolts, and other manufactured items in strict accordance with manufacturer's printed instructions and recommendations (including minimum embedment of expansion bolts).

D. After the erection and installation are complete, touch up all shop priming coats damaged during transportation and erection, using the priming paint specified for shop priming.

END OF SECTION 05 50 00

SECTION 06 10 00 – ROUGH CARPENTRY

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 QUALITY ASSURANCE

A. Grading Rules: Conform with all applicable requirements of the Western Wood Product's Association's "Western Lumber Grading Rules", latest edition, and as specifically required hereinafter.

1. Each piece of lumber or plywood used for structural framing shall be graded and marked with grade and trademark of WWPA, except that a certificate of grade from grading organization may be accepted in lieu of grade and trademarks when approved by Architect. Trademark of manufacturer shall also appear on each piece.

B. Moisture Content: Maximum moisture content shall be 19 percent.

C. Plywood Grades: Conform to American Plywood Association (APA) standard grades and specifications.

D. Glued Laminated Members shall be manufactured/fabricated (in a AITC member fabrication plant) in accordance with ANCI/AITC A190.1-1983 and conform to all requirements and recommendations of WWPA and the American Institute of Timber Construction.

1. Each member shall bear the AITC inspection stamp and combination/stress grade, or submit manufacturer's certification that glu-lam members meet these standards and specified combination/stress grade prior to incorporation of members into the Work.

E. Engineered Lumber shall bear a stamp or stamps noting the name and plant number of the manufacturer, the grade, the NER or ICC-ES report number, and the quality control agency. All members shall be manufactured with an approved adhesive.

F. Additional Reference Standards: Conform with all requirements of U.S. Department of Commerce Commercial Standards and American Wood Preservers Association Standards, as they apply.

1.2 DELIVERY, STORAGE and HANDLING

A. Deliver and store lumber on sills and cover for protection.

1.3 COORDINATION

A. Coordinate work with other trades (electrical, mechanical, plumbing, etc.) and do all cutting and patching required to accommodate their work, unless otherwise specified. Protect adjacent work as required.

1.4 MEASUREMENTS

A. Verify all dimensions shown on Drawings by taking field measurements; proper fit and attachment of all parts is required. Before commencing work, check all lines and levels indicated and such other work as has been completed. Should there be any discrepancies, immediately report in writing to Architect. In event of failure to do so, be responsible for correction of any errors.

PART 2 – PRODUCT

2.1 MATERIALS

A. See Structural Drawings for information regarding Structural Framing Members. The most stringent shall govern materials used on this project.

B. Framing lumber shall be kiln dried or MC 19 Douglas Fir or Hem-Fir graded in accordance with W.C.L.B. Grading Rules for West Coast Lumber No. 17 and grade marked by WWPA.

1. All framing lumber shall be stress grade. All sides shall be surfaced. Grades shall be as follows:

a. Joists, Rafters, Composite Headers: Douglas Fir/Larch No. 2, S-Dry.

b. Studs and Cripples: Douglas Fir/Larch No. 2 (standard grade or better at interior non-bearing walls), S-Dry.

c. Plates, Trimmers, Stringers, Misc.: Douglas Fir/Larch No. 2, S-Dry.

d. 6x Beams and Solid Headers: Douglas Fir/Larch No. 1 and better, S-Dry.

e. 4x and 3x Beams and Solid Headers: Douglas Fir/Larch No. 2 and better, S-Dry.

f. Blocking (Non-Structural): Douglas Fir/Larch No. 3 and better, S-Dry.

g. Prefabricated Wood Trusses: Shall be factory manufactured trusses of dimension and configuration required, 2 x 4 and 2 x 6 members (as detailed), Manufacturer engineered in conformance with building code, HUD Handbook 4950.2, "Design Criteria for Trussed Rafters", and loads as indicated on Drawings. Truss manufacturer shall provide all accessory items such as blocking, bridging, etc. required for a complete, engineered, roof framing system.

h. Engineered Lumber:

1) LVL: See Structural Drawings for additional information.

2) Glu-Lam Beams: See Structural Drawings for additional information.

3) Factory Fabricated Joists: See Structural Drawings for additional information.

i. Plywood Roof Sheathing: Shall be APA, Group 1, C-D Ext, Exposure 1. Thickness as noted on Drawings.

j. Plywood Wall Sheathing: Shall be APA, Group 1, C-D Ext, Exposure 1. Thickness as noted on Drawings.

k. Plywood for Interior Shear Walls: Shall be APA Group 1, 24/0, C-D Ext. Thickness as noted on Drawings.

l. Plywood for Floor Sheathing: Shall be T&G APA Sturd-I-Floor Group 1, C-D Exposure 1. Thicknesses and span rating as noted on Drawings.

m. Fire Retardant Sheathing: LP Flameblock Fire-Rated OSB sheathing, LP Flameblock Plus fire-Rated OSB Sheathing, or approved equal, 7/16" minimum.

n. Underlayment: ¼" thick APA stamped underlayment as approved by manufacturers of floor finishes under Sections 09 65 00 and 09 68 00.

o. Felt Underlay (Building Paper): 15 lb. asphalt impregnated paper felt; product of Nationally Recognized Manufacturer. Minimum grade of roofing felt shall be ASTM D-226-89 Type II.

p. Connection Hardware: Provide all connecting hardware shown or noted on Drawings, specified herein or required to complete work. Use pre-manufactured anchors, hangers, and connectors; Silver, Simpson "Strong Tie", "Trip-L-Grip", or approved. Conform to requirements of IBC.

q. Nails: Unless otherwise noted, common wire nails, galvanized if exposed to exterior, meeting Federal Specification FF-N-101, of the types and sizes required by IBC.-II-B1.

r. Screws: Standard domestic manufacture, bright steel, except galvanized for exterior use and of brass, bronze, aluminum or stainless steel when used to attach items made of those materials.

   1) Types, head configurations and sizes as noted on Drawings.

s. Bolts: Standard mild steel, square or hex head lag bolts with companion nuts and steel plate washers, or carriage bolts with companion nuts and cut washers where so indicated. Bolts, nuts and washers, wholly or partially exposed on exterior shall be galvanized.

t. Powder Actuated Fasteners: Federal Specification GGG-D-777a, install as per manufacturer's printed directions. Charge shall be powerful enough to prevent spalling of concrete.

u. Miscellaneous Clips, Steel Assemblies: Conforming to ASTM A36.

2.2 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with the requirements of AWPA U1 – Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

B. Preservative Treatment:

1. Lumber: Treat in accordance with AWPA C2 with 0.25 pcf retainage and 0.40 pcf retainage for materials in contact with soil and concrete.

2. Plywood: Treat in accordance with AWPA C9 with 0.25 pcf retainage and 0.40 pcf retainage for materials in contact with soil and concrete.

3. Pressure treatment materials shall not contain chromium or arsenic.

C. After treatment and prior to shipping, air or kiln-dry lumber to a maximum 15% moisture content.

PART 3 – EXECUTION

3.1 WORKMANSHIP

A. All rough carpentry shall produce joints true, tight, and well nailed with all members assembled in accordance with the Drawings and with all pertinent codes and regulations.

1. Carefully select all members; select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing or making proper connections. Cut out and discard all defects which will render a piece unable to serve its intended function; lumber may be rejected by the Architect, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting.

2. Do not shim sills, joists, short studs, trimmers, headers, lintels, or other framing components without receiving prior approval from the Architect.

3.2 INSTALLATION

A. Nailing: Use only common wire nails or spikes of the type and dimension, and spacing, required by IBC Table 2304.9.1, except where otherwise specifically noted in the Drawings. For conditions not covered in the IBC, provide penetration into the piece receiving the point of not less than 1/2 the length of the nail or spike; provided, however, that 16d nails may be used to connect two pieces of two inch (nominal) thickness. Do all nailing without splitting wood, preboring as required; replace all split members.

B. Plywood (Diaphragm) Nailing: Nail spacing shall conform to IBC Table 2304.9.1 and additionally to notations and schedules on Drawings.

C. Bolts: Drill bolt holes 1/32" larger than bolt diameter. Use square plate or large washers under heads and nut where they bear against wood. Retighten bolts immediately prior to final inspection.

D. Lag Screws and Screws: Subdrill, use square plate or large washers under lag screw heads when they bear on wood.

E. Typical Framing: Standard 16" o.c. Western (Platform) Framing, except as otherwise shown or noted on Drawings. Double all bearing top plates, headers and trimmers. Provide double studs at ends of all headers. Conform to IBC minimum requirements for headers, structural blocking, bridging, etc., and any more stringent requirements shown on the Drawings.

1. Provide solid bearing to foundation below all beam and header bearing points.

2. In addition to all framing operations normal to the fabrication and erection indicated on the Drawings, install all backing required for the work of other trades.

3. Set all horizontal or sloped members with crown up. Do not notch, bore, or cut members for pipes, ducts, conduits, or other reasons except as shown on the Drawings or as specifically approved in advance by the Architect/Engineer.

4. Make all bearings full, unless otherwise indicated on the Drawings. Finish all bearing surfaces on which structural members are to rest so as to give sure and even support; where framing members slope, cut or notch the ends as required to give uniform bearing surface.

5. Erection, anchorage and bridging of roof truss framing system to be per truss manufacturer's standards and engineering design.

F. Nailers and nailing strips shall be provided as necessary for the attachment of finish materials. Nailers used in conjunction with roof deck installation shall be installed flush with the roof deck system. Stacked nailers shall be assembled with spikes or nails spaced not more than 18 inches on center and staggered. Beginning and ending nails shall not be more than 6 inches from nailer end. Ends of stacked nailers shall be offset approximately 12 inches in long runs and alternated at corners. Anchors shall extend through the entire thickness of the nailer. Strips shall be run in lengths as long as practicable, butt jointed, cut into wood framing members when necessary, and rigidly secured in place.

G. Sheathing: Install sheathing panels with long dimension running across (normal to) direction of supporting members. Provide support of all panel edges by means of "ply clips", blocking, T & G joints, or other approved means per APA recommendations. Nailing as specified hereinbefore.

H. Miscellaneous Blocking and Backing: Securely install all blocking (in wood framed assemblies) required to properly support all items of finish hardware and accessories.

1. Items to be supported include, but are not necessarily limited to:

   a. Handrails
   b. Towel Bars/Rings/Hooks
   c. Shower Rods
   d. Curtain/Drapery Rods
   e. Door Stops
   f. Cabinets/Shelving
   g. Toilet Room Accessories

h. Window Treatment
i. Miscellaneous Specialty Items.

2. Also provide blocking to cut off all concealed draft openings, both vertical and horizontal (in wood framed assemblies). Maximum dimension of concealed space in stud wall shall be 10 feet.

3. Unless otherwise indicated, blocking shall be 2" (nominal) thickness and of ample width and length to accommodate possible variations in item location.

I. Accessory Items: Install accessory items such as vents, metal fabrications, etc. in strict accordance with best trade practice, per manufacturer's instructions when applicable, and as detailed or noted on the Drawings.

3.3 TERMITE CONTROL and DECAY PREVENTION

A. Remove all wood, including form lumber, scrap lumber, shavings and sawdust in contact with ground. Leave no wood buried in any fill or backfill.

B. All wood (e.g., sillplates and ledgers) in direct contact with concrete or masonry shall be pressure treated with approved preservative in oil in accordance with AWPA U1, Commodity Specifications A or F) for above ground use.

C. Ends of posts, joists, blocking, etc., in direct contact with concrete or masonry shall be treated after cutting by soaking ends, for minimum length of 12", in 5% solution of pentachlorophenol for not less than 15 minutes.

3.4 CLEAN UP

1. Keep the premises in a neat, safe, and orderly condition at all times during execution of this portion of the work, in accordance with requirements of General Conditions and Division 1.

2. At the end of each working day, or more often if necessary, thoroughly sweep all surfaces where refuse from this portion of the work has settled. Remove the refuse to the area of the job site set aside for its storage. Upon completion of this portion of the work, thoroughly broom clean all surfaces.

END OF SECTION 06 10 00

SECTION 06 20 00 – FINISH CARPENTRY and CASEWORK

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 STANDARDS

A. In addition to complying with all pertinent codes and regulations, all materials of this Section shall comply with all applicable provisions of the following:

1. American Plywood Association Grading rules (U.S.P.S. 1-74)
2. American Woodworking Institute - Casework Details
3. Architectural Woodwork Institute - Quality Standards
4. Hardwood Plywood Manufacturer's Association Standards (P.S. 51-71)
5. Western Wood Products Association Manual
6. Western Wood Products Association Standard Grading Rules

B. In the event of conflict between pertinent code and regulations and the requirements of the referenced standards or these Specifications, the provisions of the more stringent shall govern.

1.2 SUBMITTALS

A. Within 30 days of Contract execution, and per Section 01 33 00 and GENERAL CONDITIONS, submit:

1. Shop Drawings of millwork and casework at large scale, showing sizes, materials, grain run, methods of construction, connection to adjacent members and installation. Drawings for casework shall show **field** verified dimensions. Indicate all backing members required for installation and all hardware.

2. Current plastic laminate samples if and as required by Architect.

1.3 QUALITY ASSURANCE

A. For cutting and fitting trim, finish material, and casework, use only journeymen finish carpenters who are thoroughly trained and experienced in the skills required, who are completely familiar with the materials involved and the manufacturer's recommended methods of installation.

B. In acceptance or rejection of the Finish Carpentry, no allowance will be made for lack of skill on the part of workmen.

1.4 DELIVERY, HANDLING and STORAGE

A. Use all means necessary to protect lumber, finished materials and casework before, during, and after delivery to site and to protect the installed work and materials of all other trades.

1.5 COORDINATION

A. Coordinate with all other trades as required. Verify custom items scheduled to be provided under other Sections to avoid conflict or duplication and provide a complete installation as indicated on the Drawings.

1.6 MEASUREMENTS

1. Verify all dimensions shown on Drawings by taking field measurements. Proper fit and attachment of all parts is required.

PART 2 – PRODUCT

2.1 MATERIALS

A. Standing and Running Trim and Moldings (Interior): AWI quality grades; solid wood, to be painted. Sizes as detailed on the Drawings.

B. Custom Casework: Conform to AWI 'Premium' Grade reveal overlay standards in all applicable respects. Exposed solid wood and plywood parts, including faces and edges of drawers and doors, shall be plastic laminate faced and edged; color as selected.

1. Edges of door panels, cabinet bodies, and shelves shall be pressure applied 3 mm PVC edgebanding.

2. Semi exposed parts (cabinet interiors), behind opaque doors and where indicated on the plans, shall be melamine or polyester overlaid 45# density particle board wherever visible from standing or crouching position with doors open. All interior adjustable shelves other than open bookshelves shall be melamine overlaid; color as selected.

3. Drawer bottoms shall be ¼" HDO plywood or tempered hardwood. Drawer sides shall be melamine surfaced particleboard All colors as selected.

C. Cabinet Hardware: Unless otherwise noted, all exposed items shall be of finish US26D (as selected) (or approved by Owner).

1. Adjustable Shelving Supports - Halele, or equivalent, chrome steel shelf support or equivalent, to fit manufacturer's support holes.
2. Drawer Slides - Accuride E3634
3. Door Hinges - Concealed, self-closing "European Type" for (overlay) type doors, Grass 3000 series, or approved, #3903 unless otherwise required by detail or conditions.
4. Door Catches - National Lock, or equivalent, heavy duty catch, aluminum.
5. Door and Drawer Pulls - ½" bent wire pulls. Stanley #448 3 ½" or equivalent

D. Plastic Laminate: High pressure, 1/16" on horizontal surfaces, splashes, self-edges, or elsewhere, as detailed. Formica, Wilson Art, Nevamar or approved, exact color as selected from standard stock color samples. Provide companion balancing sheet at all applications, unless opposite face is of approved plastic, impregnated or overlain, or secured permanently to framing.

E. Other Materials: All other materials, not specifically described, but required for a complete and proper installation as indicated on the Drawings, shall be new suitable for the intended use, and subject to the approval of the Architect.

PART 3 – EXECUTION

3.1 FABRICATION

A. General

1. All casework and millwork items to be manufactured and fabricated in fully equipped millwork and cabinet shop. All work to be uniformly sanded to even surface texture prior to leaving shop. Conform strictly to applicable AWI standards.

B. Custom Casework:

1. AWI, 'Premium' Grade, reveal overlay, and as detailed on Drawings.

C. Millwork and Trim:

1. Produce exact shapes detailed and/or called for on the Drawings, in as long of lengths as practical.

2. Mill all items on clean, sharp, machinery of ample capacity for the work. Do not force work. Torn edges and skips will be cause for rejection. Maintain end match of grain type and precise dimension for continuing and adjoining pieces.

3. Ease all wood edges that will be exposed when installed to 1/16" facet, unless otherwise indicated on Drawings.

3.2 INSPECTION

A. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence. Verify that finish carpentry may be completed in strict accordance with the original design and all pertinent codes and regulations. In the event of discrepancy, immediately notify the Architect. Do not proceed with installation until all such discrepancies have been fully resolved.

3.3 INSTALLATION

A. Priming:

1. Back-paint all wood surfaces inaccessible and unexposed after installation before delivery with an approved linseed oil and primer, unless prefinished on all surfaces with specified and scheduled finish.

a. Prime coat all unfinished metal parts.

B. Finish Carpentry:

1. Install all work to details shown, and as required, plumb, level, true to line and securely anchored. Make accurate scribes where required. Miter outside corners, and scribe one piece neatly to other at inside corners. Install longest possible length, in order to minimize number of joints. Leave no end grain or panel edges exposed, unless specifically so detailed on Drawings.

2. End splices in interior running trim shall be butt joint, grain matched, glued and doweled.

3. Trim shall be secured with small headed nails. Set nails, and fill with putty.

4. Hammer marks not acceptable on any exposed finished surface and will be cause for rejection of work by Architect.

C. Installation of Hardware, etc.:

1. Install all other items in strict accordance with the Drawings and the published recommendations of the manufacturer of the item, anchoring firmly in place at the prescribed location, straight, plumb and level. Adjust as required for proper operation.

D. Finishing:

1. Sandpaper all finished wood surfaces thoroughly as required to produce a uniformly smooth surface, always sanding in the direction of the grain. No coarse grained sandpaper mark, hammer mark, or other imperfection will be accepted. Finishes as specified in DIVISION 9.

END OF SECTION 06 20 00

SECTION 07 11 00 – DAMPPROOFING

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SCOPE OF APPLICATION

A. Apply to all below grade exterior earth faces of concrete footings, foundations, walls, etc., unless specifically indicated not to receive dampproofing.

1.2 COORDINATION

A. Coordinate work under this Section closely with work of all adjacent trades. Whenever the watertightness of the dampproofing is dependent on other trades, assume full responsibility for watertightness of the finished installation.

1.3 GUARANTEE

A. Per GENERAL CONDITIONS, furnish a written guarantee, countersigned by the General Contractor, that all liquid dampproofing is unconditionally guaranteed to be watertight for a period of 2 years.

1.4 DELIVERY, HANDLING and STORAGE

A. Deliver materials to job site in manufacturer's original, unopened packaging and adequately protect against damage while temporarily stored at site.

B. Use all means necessary to protect the installed work of this Section.

C. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 – PRODUCT

2.1 MATERIALS

A. Materials designated for a specific application shall be the products of one manufacturer.

B. Liquid Dampproofing: "Master Builders MasterSeal 610" by SIKA, or approved, below grade exterior dampproofing for spray application.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Surface Condition: Examine all subsurfaces and verify that they are in proper condition to receive work of this Section. Do not proceed until improper conditions are corrected. Surface must be clean and free of foreign matter. All cracks, voids, honeycombs, etc., shall be filled and repaired with mortar to provide a sound structural surface and to allow dampproofing to properly bridge joints.

B. Application: Do work only in dry weather and apply in strict accordance with manufacturer's written specifications and instructions.

1. Not less than 2 coat (plus prime) application. Allow first coat to dry to "tacky" state (24 hours) before applying second.

2. Prior to applying final coat, prime surface by spraying thoroughly with a liquid of specified dampproofing primer cut a maximum of 20% with clean water.

3. For final spray coat application apply (after prime coat) at full strength with uniform coverage of at least 1 gal/100 sf.

END OF SECTION 07 11 00

SECTION 07 20 00 – INSULATION

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide and install all thermal insulation indicated on Drawings or required herein, except:

1. Insulation related to mechanical work is specified in DIVISIONS 22 and 23.

B. The structure is to be constructed with a continuous air barrier at the perimeter of the thermal envelope. The air barrier shall be uninterrupted and/or sealed at all intersections of roof wall and at all penetrations.

1. Coordinate with Section 07 26 00.

2. See Section 01 35 00 for testing requirements.

1.2 LABELS

A. Manufacturer's labels required on each piece or package of insulation. Do not remove labels or open packages until Architect inspects and approves. Clearly identify contents, brand name, applicable standard, and R-value.

1.3 DELIVERY, HANDLING and STORAGE

A. Delivery materials to Project site in manufacturer's original packaging. Store materials off the ground. Protect against weather, condensation, and damage.

PART 2 – PRODUCT

2.1 MATERIALS

A. Perimeter Insulation (Insulation Type-1) (concealed/below grade): Dow Chemical "Styrofoam-Square Edge", minimum R5.0 per inch, 2" thick unless otherwise noted.

B. Flexible Blanket Insulation (Insulation Type-2) (Walls and Roofs): Manville, Certainteed, or Owens-Corning Fiberglass, foil faced, with flame spread rating not over 25, R-11, R-19, R-21, R-25, R-30, R-49, etc. R-Values as shown on Drawings. Rockwool or Fiberglass insulation with fire-rated vapor barrier of other manufacturers will be accepted, subject to meeting `R' Values.

1. Where concealed behind gypsum wallboard or gypsum base, unfaced fiberglass batts may be used in conjunction with plastic vapor barrier as specified in Section 07 26 00.

C. Rigid Wall Insulation (Continuous Insulation Type 3): Thermal insulation board composed of a closed-cell polyisocyanurate foam core bonded to reinforced aluminum foil, ¾" thickness = R-5.0, R-Max Thermasheath-3 or approved equal.

D. Sound Batt Insulation (acoustical batts): Per Sections 09 50 00.

2.2 SCOPE OF APPLICATION

A. Blanket Insulation: Install full height in exterior walls and ceilings below unheated attics.

B. Perimeter Insulation: At entire perimeter of building, from slab as detailed, to top of footing or to at least 24" below finished grade.

C. Rigid Wall Insulation: Full height of exterior walls as scheduled, meeting the "continuous insulation" requirements of the Washington State Energy Code.

PART 3 – EXECUTION

3.1 INSTALLATION

A. In accordance with manufacturer's directions for the specific application with recommended adhesives or fastening devices. Fit insulation together snugly. Maintain integrity of insulation over entire area or warm space side.

B. Install flexible blanket insulation with ends and edges tight, supported by stripping, edge tabs lapped and stapled to face of studs. Install with foil or vapor barrier on room or warm space side.

C. Install insulation to attain maximum R-value possible for finished assembly.

3.2 CLEAN UP

A. Remove and dispose of excess materials, litter and debris, leaving work areas and site in a clean condition.

END OF SECTION 07 20 00

SECTION 07 26 00 – VAPOR BARRIERS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 GENERAL

A. The structure is to be constructed with a continuous air barrier at the perimeter of the thermal envelope. Vapor barriers, sheeting, etc. shall constitute the air barrier where they apply to the assembly.

1. The air barrier shall be uninterrupted and/or sealed at all intersections of roof wall and at all penetrations.

2. See Section 01 35 00 for testing and building envelope air leakage requirements.

1.2 QUALITY ASSURANCE

A. Installation of vapor and weather barriers shall be performed by experienced personnel.

1.3 DELIVERY HANDLING and STORAGE

A. Deliver and store materials in manufacturer's unopened packages. Protect products from punctures, cuts, or other damage which would affect performance of the installation.

PART 2 – PRODUCT

2.1 MATERIALS

A. Polyethylene Sheeting: Conform to sheeting ES LP-378C, Type 1; Clear (unless otherwise noted). Acceptable manufacturers - Arco/Polymers (Durethene); Gering Plastics Company (Ger. Pak); Mobil Oil Company.

1. 10 mil thickness under interior slabs on grade.

2. 4 mil vapor barrier at exterior insulated walls, unless foil faced batts are called for, or wall assembly is noted on Drawings as not requiring vapor barrier.

B. Tape: Splicing and air barrier tape as approved by sheeting manufacturer.

C. Weather Barrier: DuPont Tyvek CommercialWrap or approved equivalent, spunbonded, polyolefin, non-woven, non-perforated, weather barrier.

1. Performance Characteristics:

a. Air Penetration: 0.001 cfm/ft^2 at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677. ≤0.04 cfm/ft^2 at 75 Pa, when tested in accordance with ASTM E2357

b. Water Vapor Transmission: 28 perms, when tested in accordance with ASTM E96, Method B.

c. Water Penetration Resistance: 280 cm when tested in accordance with AATCC Test Method 127.

d. Basis Weight: 2.7 oz/yd^2, when tested in accordance with TAPPI Test Method T-410.

e. Air Resistance: Air infiltration at >1500 seconds, when tested in accordance with TAPPI Test Method T-460.

f. Tensile Strength: 38/35 lbs/in., when tested in accordance with ASTM D882, Method A.

g. Tear Resistance: 12/10 lbs., when tested in accordance with ASTM D1117.

h. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E 84. Flame Spread: 10, Smoke Developed: 10.

B. Ice Shield: See Section 07 41 13

C. Self-Adhered Flashing for windows, doors, wall openings: GCP Applied Technologies "Vycor Plus", cross-laminated, high-density polyethelene sheet with pressure-sensitive rubberized asphalt adhesive.

D. Fasteners, adhesives, primers, and other products required by the manufacturer for a complete and warrantable system.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Lay in widest practical widths. Where splices are made, overlap 12 inches minimum.

B. Protect from puncture and other damage. Replace or repair all damaged material before proceeding with subsequent work (e.g., slabs, etc.).

C. Air Barrier:

1. Polyethylene sheeting, fire retardant vapor barriers, splicing tape, shall be utilized to form a continuous air barrier and shall be installed to conform to the building envelope air leakage requirements.

a. Air barrier joints and seams shall be sealed, including sealing transitions in places and changes in materials. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from the wind, stack effect and mechanical ventilation.

b. Penetrations of the air barrier shall be sealed in a manner compatible with the construction materials and location. Sealing shall allow for expansion, contraction and mechanical vibration. Joints and seams associated with penetrations shall be sealed in the same manner or taped. Sealing materials shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the penetrations' ability to resist positive and negative pressure

from wind, stack effect, and mechanical vibration. Sealing of concealed fire sprinklers, where required, shall be in a manner that is recommend by the manufacturer.

2. Apply tape at seams and joints of sheathing and other perimeter surfaces in addition to the locations of vapor barriers to effectively seal the building as needed to conform to the air leakage requirements.

D. Weather Barrier:

1. Wrap all soffits and gables with house wrap.
2. Install flashing system in conjunction with house wrap at all penetrations through walls, including duct and window penetrations to mitigate air infiltration through penetrations.

END OF SECTION 07 26 00

SECTION 07 41 13 – PREFORMED METAL ROOFING

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Provide all preformed metal roofing including underlayment felts, attachments, spacers, blocking, closure strips, coping, cap flashing, flashing collars, caulking, clips, cants, etc., as required by the manufacturer, as shown on the Drawings, and as specified herein. The Preformed Metal Roofing installation shall be a complete and watertight assembly in all respects.

1.2 SUBMITTALS

A. Submit the following in accordance with the General Conditions and DIVISION 1.

1. List of materials to be used, identifying manufacturers and any suggested detail revisions. Incorporate any required detail revisions, as approved by the Architect, in the Project at no additional cost to the Owner.

2. Prior to Application for 100% Completion Payments:

a. (2) copies of processed, signed and countersigned guarantee(s) as specified above and certifications that materials conform to these Specifications.

1.3 GUARANTEES

A. The Contractor shall unconditionally guarantee in writing the watertightness of all roofing related work for a period of two years from date of acceptance of the Work by the Architect and Owner.

B. In addition, provide the manufacturer's standard thirty (30) year Kynar 500 Commercial, Non-Transferable, Non-Prorated Limited Warranty for metal roofing finish.

1.4 QUALITY ASSURANCE

A. Standards and Workmanship:

1. All work shall be done by a preformed metal roofing contractor approved by the manufacturer and the Architect. All work shall be installed in strict accordance with roofing materials manufacturers' directions and recommendations, highest standards of trade practice and all applicable codes and regulations.

B. Coordination:

1. Coordinate work of this Section closely with framing, plumbing vents, exhaust ducts and any other adjacent trades so as to ensure a complete and watertight assembly in all respects.

C. Pre-Application Requirements:

1. Review preformed metal roofing detail drawings and specifications with metal roofing manufacturer to verify that materials are properly used.

1.5 DELIVERY, HANDLING and STORAGE

A. Deliver materials to job site in manufacturer's original protective wrapping. Fully protect against wetness, exposure to sun's rays and other damage while temporarily stored. All materials designated for a specific application shall be the products of one manufacturer.

1.6 JOB CONDITIONS

A. Construction Traffic:

1. Protect roofing materials and take precautions to prevent damage of new, preformed metal roof surfaces during and after construction. Repair any damaged materials immediately art no additional cost to Owner.

PART 2 – PRODUCT

2.1 GENERAL

A. Except as otherwise indicated or approved, all components of the preformed metal roof shall be the products of the same manufacturer and shall meet the minimum standards of applicable ASTM Standards and/or Federal Specifications.

2.2 MATERIALS

A. Metal Roofing:

1. Shall be MS-150 Mechanically Seamed system as manufactured by Taylor Metal Products, 4566 Ridge Drive NE, Salem, Oregon 97301 (503) 581-8338. Equal products by AEP Span and Metal America may be substituted, subject to submittal approval. Equal products by other manufacturer's must be prior approved in accordance with Division 1.

a. Panels and seams shall be roll-formed in continuous lengths. 16" coverage, "Striations" panel option, material shall be hot dipped, galvanized, 24-gauge steel, Kynar 500 factory applied fluorocarbon finish; color as selected by Architect from manufacturer's standard cool Kynar 500 colors.

B. Metal Flashings and Trim: See Section 07 62 00.

C. Synthetic Sheet Flashings:

1. Gates "Contourflash", "Nervastral", or approved elastomeric flashing sheet material of specific type and thickness recommended by manufacturer for particular application.

D. Snow Stops: S-5 ColorGard snow guards, or approved equal.

E. Ice Shield: Cold-applied, self adhering membrane composed of a high density, cross laminated polyethylene film coated on one side with a layer of rubberized asphalt adhesive. An embossed, slip resistant surface is to be provided on the polyethylene. Supply wound with a disposable silicone-coated release sheet.

1. Color: Gray-Black
2. Thickness: 40 mil, ASTM D3767 procedure A (Section 9.1)
3. Tensile strength, membrane: 250 psi, ASTM D412
4. Elongation, membrane: 250%, ASTM D412
5. Low Temperature flexibility: Unaffected @ - 20 degrees Fahrenheit, ASTM D1970
6. Adhesion to plywood: 3.0 lbs/in. width, ASTM D903.
7. Permeance (max): 0.05 perms, ASTM E96.
8. Material weight installed (max): 0.3 lb/sq ft, ASTM D461.

F. Pre-Fabricated Pipe Flashing Collars:

1. "Oatey", Buildex "Dektite", or approved, monolithic EPDM elastomeric collar units.

G. Miscellaneous:

1. Furnish any required caulking, nails, clips, cants, etc., required for a proper completion of installation whether shown or called for, or as required by the manufacturer for his application as directed.

PART 3 – EXECUTION

3.1 FABRICATION

A. Shop fabricate all custom shapes and components as required by Drawings and actual job conditions. Fabricate all components for expansion type concealed clip attachment.

3.2 INSTALLATION

A. Prior to commencing preformed metal roofing operations, roof sheathing deck shall be smooth and sound with nailers, curbs and cants, skylites, fascia blocking, etc., in place and complete. All items required by other sections for building into roofing shall be on hand and ready to install.

B. Remove all extraneous materials from roof deck; sweep clean and free of all objects which may puncture underlayment. The only materials allowed on the roof deck to be roofing materials in process of application and roofers' appliances and tools. Deck shall be dry, with no visible moisture or frost present.

C. Install ice shield according to manufacturer’s requirements. Ice shield shall be installed throughout the entire roof, see drawings for additional information.

D. Roofing Application:

1. Apply preformed metal roofing assembly in strict accordance with manufacturers' printed directions and recommendations, and as detailed on the Drawings. Maximum spacing of main attachment clips shall be 18" o.c. (24" o.c.)

2. All attachments shall be concealed type allowing for movement of expansion and contractions of all components over 24" in any dimension without buckling or loosening. All joints shall be interlocked with no surface or exposed fastenings.

3. Furnish and install all required miscellaneous flashing collars around mechanical penetrations, trims, flashing, clips, channels, and other accessory items required for proper completion of work under this Section.

4. Install snow stops in strict accordance with manufacturers' printed directions and recommendations.

3.3 CLEANING

A. Remove all excess materials and debris from site. Touch up damaged painted areas with manufacturer approved touch-up paint.

END OF SECTION 07 41 13

SECTION 07 42 13 – METAL WALL PANELS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Work applies to all exterior siding and wall panels.

B. See Section 07 41 13 for preformed metal roofing.

1.2 SUBMITTALS

A. Submit the following for review by the Architect:

1. (Minimum of) 2 - 12" x 12" sample pieces of wall panel with corner section cut, for each color selected.

2. Complete manufacturers' technical data, including instructions and recommendations for installation, guarantee data, and complete standard color line, for selection.

3. At completion of work submit, as a part of O & M Manuals, manufacturers' maintenance instructions and certification of guarantee as specified.

B. Guarantee

1. Manufacturers' standard year guarantee against delamination, deterioration, cracking, crazing or fading of material. Also guarantee entire installation including weathertightness for one year.

2. In addition, provide the manufacturer's standard thirty (30) year Kynar 500 Commercial, Non-Transferable, Non-Prorated Limited Warranty for metal siding finish.

1.3 QUALITY ASSURANCE

A. For cutting and fitting material, use only skilled workmen who are thoroughly trained and experienced in the skills required, who are completely familiar with the materials involved and the manufacturers' recommended methods of installation.

B. In acceptance or rejection of the work, no allowance will be made for lack of skill on the part of workmen.

1.4 DELIVERY, HANDLING and STORAGE

A. Panels shall be unloaded and stored in a dry space with proper blocking materials and covers to prevent change until erection is started. Damaged or defective material shall be replaced at no cost to the Owner. Panels shall be stored off of the ground.

1.5 JOB CONDITIONS

A. Measurements

1. Verify all dimensions shown on Drawings by taking field measurements. Proper fit and attachment of all parts is required.

B. Coordinate with all other trades as required. Provide a complete installation as indicated on the Drawings.

PART 2 – PRODUCT

2.1 GENERAL

A. Except as otherwise indicated or approved, all components of the metal wall panels shall be the products of the same manufacturer and shall meet the minimum standards of applicable ASTM Standards and/or Federal Specifications.

2.2 MATERIALS

1. Metal Wall Panels: 24 gauge, HR-34 metal wall panel as manufactured by Taylor Metal Products, 4566 Ridge Drive NE, Salem, Oregon 97301 (503) 581-8338. Equal products by AEP Span and Metal America may be substituted, subject to submittal approval. Equal products by other manufacturer's must be prior approved in accordance with Division 1.

2. Finish: Kynar 500 factory applied fluorocarbon finish; color as selected by Architect from manufacturer's standard cool Kynar 500 colors.

3. Provide full length panels.

4. All metal flashing and trim, required for a watertight installation and as required by the drawings shall be provided from the same manufacturer as the panels and in the same color.

B. Miscellaneous: Furnish any required caulking, nails, clips, cants, etc., required for a proper completion of installation whether shown or called for, or as required by the manufacturer for his application as directed. Rivets, clips, straps, etc. exposed in wall panels, flashing, etc. shall be color matched.

PART 3 – EXECUTION

3.1 SURFACE CONDITIONS

A. Examination

1. The Contractor shall verify installed work of other trades such work is complete to a point where the roofing system installation may commence.

2. Verify that the substrate installation is in accordance with the approve shop drawings and Metal Wall Panel manufacturer's requirements. This specifically includes verifying that the secondary structural members and/or decking are installed to meet performance requirements. Coordinate with Metal Wall Panel System Manufacturer to ensure that the substrate is installed to accommodate the appropriate fastener spacing.

B. Discrepancies

1. In event of discrepancy, notify the Architect.

2. Do not proceed with installation until discrepancies have been resolved.

3.2 INSTALLATION

A. Install the Metal Wall Panel system plumb, true and in correct alignment with support, in accordance with the manufacturer's instructions and approved shop drawings.

B. Install panels so that it is weathertight and allows for thermal movement.

C. Locate and space all exposed fasteners in accordance with the manufacturer's recommendations. Use proper torque settings to obtain controlled uniform compression for a positive seal without rupturing the neoprene washer.

D. Avoid placing pipe and electrical penetrations through panel seams.

E. Do not allow panels or trim to come into contact with dissimilar materials (i.e. copper, lead, graphite, treated lumber, mortar, etc.). Water run-off from these materials is prohibited.

3.3 CLEANING, PROTECTION

A. Dispose of excess materials and remove debris from the site.

B. Clean work in accordance with manufacturer's recommendations.

C. Leave panels free from dirt, markings, scratches, dents, warpage and other damage. Remove sealants from exposed surfaces before sealant cures. Do not use abrasives, caustic or acid cleaning agents in cleaning the surfaces of the panels.

D. Replace panels and other components of the work which have been damaged or have deteriorated beyond successful repair by means of touch-up or similar minor repair procedures.

E. Protect work from damage until final acceptance.

END OF SECTION 07 42 13

SECTION 07 46 00 – FIBER-CEMENT SOFFITS AND TRIM

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Fiber-cement soffits

B. Fiber-cement trim

1.2 REFERENCES

A. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets.

B. ASTM D3359 - Standard Test Method for Measuring Adhesion by Tape Test, Tool, and Tape.

C. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

1.3 SUBMITTALS

A. In accordance with the requirements of Section 01 33 00, submit:

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Installation methods.

C. Selection Samples: For each finish product specified.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Minimum of 2 years' experience with installation of similar products.

B. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1.5 DELIVERY, HANDLING and STORAGE

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store siding on edge or lay flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.7 WARRANTY

A. Product Warranty: 30 Express Limited Product warranty for soffit and trim products.

B. Workmanship Warranty: Application limited warranty for 2 years.

PART 2 – PRODUCT

2.1 MANUFACTURES

A. James Hardie Building Products, Inc., other manufacturer's products must be prior approved.

2.2 FIBER-CEMENT SOFFIT PANELS

A. Vented smooth soffit panels.

2.3 FIBER-CEMENT TRIM

A. Trim Size: Sizes as indicated on the Drawings with square edges. Surface Texture: Smooth.

2.4 FASTENERS

A. Fasteners must be corrosion resistant, galvanized, or stainless steel.

2.5 FINISHES

B. Factory Primer: Provide factory applied universal primer.

1. Primer: Factory primed by James Hardie.

2. Topcoat: Refer to Section 09 91 00 PAINTING.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Do not begin installation until the substrates have been properly prepared.

3.2 INSTALLATION

A. Install materials in strict accordance with manufacturer's installation instructions.

END OF SECTION 07 46 00

SECTION 07 62 00 – MISCELLANEOUS FLASHING and SHEET METAL

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Supply and install all counterflashings and miscellaneous flashings not specified elsewhere and sheet metal work as shown on Drawings and as specified herein.

1.2 STANDARDS

A. In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations contained in "Architectural Sheet Metal Manual", latest edition, of the Sheet Metal and Air Conditioning Contractors' National Association, Inc., (SMACNA), and recommended details and procedures of the National Roofing Contractors' Association (NRCA), insofar as they are applicable.

1.3 SUBMITTALS

A. Submit manufacturer's published literature for specified products and accessories as applicable, including manufacturers' specifications, physical characteristics and performance data; instructions and directions for application.

B. Submit complete shop drawings of all flashing and sheet metal proposed to be furnished and installed to the Architect for his review. Allow ample time for revision and resubmittal as may be necessary.

1.4 GUARANTEE

A. Furnish a written guarantee, countersigned by the General Contractor, that all sheet metal work is unconditionally guaranteed to be watertight and free of defects for a period of 2 years.

1.5 DELIVERY, HANDLING and STORAGE

A. Deliver and store materials in dry, protected areas. Keep free of corrosion or other damage. Use all means necessary to protect flashing and sheet metal materials before, during and after installation and to protect the installed work and materials of all other trades.

1.6 JOB CONDITIONS

A. Coordination

1. Coordinate and cooperate with any other trades whose work relates to sheet metal in any way.

B. Measurements

a. Verify all dimensions shown on Drawings by taking field measurements; proper fit and attachment of all parts is required.

PART 2 – PRODUCT

2.1 MATERIALS

A. General: Where sheet metal is required and no material or gauge is indicated on the Drawings, furnish and install the highest quality and gauge commensurate with the referenced standards.

B. Pre-Finished Steel Sheet for Coping, Flashing, Downspouts: Aluminum-zinc coated steel sheet as a standard material with fluoropolymer "Kynar 500" or "Hylar 5000" factory finish, gauge per Drawings. Color from manufacturer's standard colors to match roofing and siding color.

C. Steel Stiffeners: A7 structural steel, galvanized.

D. Galvanized Sheet Steel: Conforming to ASTM A90-69 or A446-76, as required, and shall be "Armco-Zincgrip Paintgrip" as manufactured by Armco Steel Corp., or approved equal. Where sheet metal gauges are not noted on Drawings or shown in SMACNA details, use #24 gauge. Use #20 gauge minimum for clips.

E. Pre-Fabricated Pipe Flashing Collars: "Oatey", Buildex "Dektite", or approved, (composite sheet metal and EPDM type).

F. Synthetic Elastomeric Sheet Material: Gates "Countourflash", "Nervastral", or approved, of type and thickness recommended by manufacturer for particular application, and/or as called for on Drawings.

G. Reglets and Counterflashing: Fry Reglet "MA" - Masonry Springlok flashing system as detailed or required. Use only factory prefabricated corners.

H. Nails, Rivets, and Fastenings: Nails shall be hot-dip, galvanized for galvanized steel.

I. Fastenings: Nails, bolts and nuts, power driven fasteners, screws, washers, etc., must be hot-dip, galvanized or stainless steel.

J. Anchors: For fastening items to masonry or concrete shall be galvanized machine screws or bolts and "Rawl" plug inserts or Phillips "Red Head" anchors of the size and type noted or required.

K. Solder: Shall be Grade A, conforming to ASTM B32-76, composed of 50% pig lead and 50% block tin, warranted pure. No remelted or reworked solder shall be used.

L. Flux: Shall be muriatic acid killed with zinc, or an approved brand of soldering flux, for galvanized steel. Flux shall be thoroughly washed off after soldering, is completed.

M. Cement Bituminous plastic, Fed. Spec. SS-C-153.

N. Paper Underlayment: 6 pound, rosin-sized.

O. Building Paper: Waterproof, Fed. Spec. UU-P-147, 15# weight.

P. Sealants: GE, DAP, Morrison and Company, or approved, first quality polyurethane, or polyisobutylene including primer, as required.

Q. Butyl Sealer: Where impractical to use solder at joints, corners, etc., seal with "DAP Butyl Gutter and Lap Sealer", or "Cushion-Lock CL-50 Butyl Sealer".

R. Lead and Oil: Red lead primer: Fed. Spec. TT-P-86a, Type II.X

PART 3 – EXECUTION

3.1 INSPECTION

3.2 Examine all subsurfaces to receive work under this Section and verify that they are in proper condition to commence work of this Section. Do not proceed until improper conditions are corrected.

3.3 FABRICATION

A. Fabricate sheet metal flashing and other items to shapes and sizes as detailed and required, allowing sufficient material for up-standing leg. Make surfaces free of waves and buckles, with lines, and angles sharp and true. Form in strict accordance with detailed Drawings. Workmanship shall be equal to best standards of modern sheet metal practices.

B. Join parts by soldering, or with concealed rivets or sheet metal screws where necessary for strength or stiffness. Place sheets together before drilling. Where lap joints are used, lap sheets at least 4 inches.

C. Roof Flashings: Specified under Roofing Sections.

D. Copings (as may be required): Fabricate to detail in approximately 8 ft. lengths of 24-gauge, galvanized steel. Cover wood plate with 30-pound roofing before installing coping. Lock exposed edge over continuous cleats of same material, securely nailed to plate.

E. Clean All Surfaces Before Soldering: Perform soldering slowly with well heated tools to thoroughly heat the sheet and completely sweat the solder through full width of seam. All lock seam work shall be flat and true to line and be sweated full of solder. All flat lock seams, and lap seams, where soldered, shall be at least 1/2" and made in direction of drainage flow.

1. Thoroughly wash all acid flux work after soldering.

3.4 INSTALLATION

A. Conform to quality, procedures and methods recommended by National Association of Sheet Metal Contractors. Accurately form, fit snugly, have exposed edges folded under at least 1/2" and no sharp edges or corners left exposed.

1. Properly shield against galvanic action with asphalt base paint or equivalent. Securely fasten and make absolutely watertight.

2. Provide expansion joints at all junctions and at straight runs at intervals not exceeding 20 feet. Form, fabricate, and install all sheet metal so as to adequately provide for expansion and contraction in the finished work. Select type best suited and least obtrusive for conditions and make watertight with sealant. Shop-form corners, extending not less than 1' each side of corner.

B. Attach sheet metal (and reglets) to surfaces which are even, smooth, sound, thoroughly dry and clean, free of all defects which might affect application.

1. Use concealed clips, cleats and/or slotted nail hole attachments only, and as required to allow for expansion and contraction without buckling or loosening. No nails or other attachments shall be exposed to weather, unless specifically approved by Architect due to extraordinary circumstances. If exposed attachments are necessary, and approved, set in elastomeric roofing cement.

2. Any materials furnished hereunder to be built into work by others shall be in condition for final installation. Do all cutting, fitting, drilling or other operation in sheet metal required to accommodate work of other trades.

3. Provide any items essential to complete the installation, though not specifically shown or specified, of the same kind, quality and type as similar items utilized elsewhere in the building. Apply all sealant and butyl tape per requirements of Section 07 92 00.

C. Flashings and counterflashings shall be installed at all points as shown or necessary to make Work watertight. Joints shall be expansion type joints conforming to NRCA recommended detail. Make no joints within 18" of corners.

3.5 CLEANING and FINISHING

A. Clean all surfaces not concealed after installation, carefully removing grease and oil with solvent or gasoline and wiping with clean rags.

B. Finish: Any non-prefinished visible flashings and counterflashings shall be painted, per Section 09 91 00 **.**

END OF SECTION 07 62 00

SECTION 07 92 00 – CAULKING AND SEALANTS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Provide all caulking and sealing work as shown on the Drawings or required for an air and totally moisture tight building. Certain types and applications of caulking, related to specific trade applications may be specified elsewhere, and take precedence over this Section for the work of the Section wherein they appear.

B. The structure is to be constructed with a continuous air barrier at the perimeter of the thermal envelope. Caulking and sealant work shall be performed at locations where penetrations or other devices may create a leak in the perimeter air barrier system.

1. Caulking and sealant work shall be performed at locations where penetrations or other devices may create a leak in the perimeter air barrier system.

2. Coordinate with the requirements of any pre-engineered structures.

3. See Section 01 35 00 for testing and building envelope air leakage requirements.

1.2 GUARANTEE

A. Provide a written guarantee warranting caulking to be free of all defects in materials and workmanship for a period of 5 years from date of acceptance of building. Leakage, hardening, staining, separation, crumbling, running, melting will be considered defects; replace all defective caulking at no cost to the Owner.

1.3 SUBMITTALS

A. Submit manufacturers' published literature, including instructions for application, for specified products and accessories as applicable, including manufacturers' specifications, physical characteristics and performance data.

1.4 QUALITY ASSURANCE

A. Installation of caulking shall be performed only by workmen thoroughly skilled and specially trained in the techniques of caulking, and who are completely familiar with the published recommendations of the manufacturer of the caulking material being used.

1.5 DELIVERY, HANDLING AND STORAGE

A. Deliver caulking and sealant materials to site in manufacturers' original sealed containers.

B. Store all caulking materials and equipment under conditions recommended by its manufacturer. Do not use materials stored for a period of time exceeding the maximum recommended shelf-life of the material.

C. Use all means necessary to protect caulking materials before, during and after installation and to protect the installed work and materials of all other trades. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect.

PART 2 – PRODUCT

2.1 CAULKING AND SEALANT

A. All caulking and sealant materials, unless otherwise specifically approved by the Architect, shall be a single component, high performance, primerless, non-sagging type. Color approved by the Architect where exposed to view.

1. Sealant - General Use, Interior and Exterior: Silicone based building sealant, GE 'Silpruf', Master Seal "DegaSeal 100", Dow Corning 795, Tremco 'Spectrum 2', Rhodorsil 5C, or as approved by Architect. Color to be selected from manufacturer's standards.

2. Sealant-Toilet Rooms/Showers: GE 'Sanitary 1700', Dow Corning 786 or approved equal, mildew resistant silicone based sealant.

3. Back-Up Material: Foamed polyethylene or polystyrene rod stock, sizes as required by joint conditions, "Ethaform SB", PRC "Minicel", or approved.

4. Butyl Tape: Extruded polyisobutylene tape CL-50 as manufactured by Chemical Sealing Corp. "Cushion-Lock".

PART 3 – EXECUTION

3.1 INSTALLATION

A. Examine subsurfaces and verify that they are in proper condition before commencing work of this Section. Do not proceed until improper conditions are corrected.

B. Preparation:
1. Clean and prepare surfaces to which sealant is to be applied, per manufacturers' recommendations.
2. All surfaces shall be dry and free from loose materials.
3. Prime surfaces if recommended by manufacturer.

C. Required Application (General Use): Where identified as "Sealant", "caulk", or "calk" on Drawings, provide complete sealing system, including back-up as follows:

1. Where more than 1/2" deep, install back-up rod compressed a minimum of 30% to within 1/4" of surface.

2. Where 1/2" deep or less, apply tape to bottom of joint to prevent adhesion of sealant.

D. Building Envelope Air Barrier

1. Air barrier joints and seams shall be sealed, including sealing transitions in places and changes in materials. All seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from the wind, stack effect and mechanical ventilation.

2. Penetrations of the air barrier shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Sealing shall allow for expansion, contraction and mechanical vibration. Joints and seams associated with penetrations shall be sealed in the same manner or taped, coordinate with Section 07 24 00. Sealing materials shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the penetrations' ability to resist positive and negative pressure from wind, stack effect, and mechanical vibration. Sealing of concealed fire sprinklers, where required, shall be in a manner that is recommend by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.

E. Other locations of application include, but are not limited to the following:

1. Apply bead of approved sealant at top of all plastic laminate countertops at wall to provide a continuous seal.

2. Apply bead of approved sealant around connection of accessories at wall, such as grab bars, towel bars, paper dispensers, soap dishes, etc., provided on or within walls to protect structural elements from moisture.

3. Apply a bead of approved sealant at connection of plumbing fixtures to wall surface, such as wall hung lavatories, urinals, etc.

4. Apply a continuous bead of approved sealant at vinyl or concrete flooring to base of hand wash sink, floor sink, floor mounted water closets, or tub/shower unit.

5. Apply a continuous bead of approved sealant behind vinyl cove base at joint of vinyl flooring to gypsum board wall and particle board underlayment to ensure a watertight seal.

6. Apply a full bead of approved sealant behind reinforced fiberglass panels at joint of floor to wall board. Color: white.

7. Apply a full bead of approved sealant between all interior walls and woodwork, baseboards, doorways, and relite frames. Color as selected.

8. Apply a full bead of approved general purpose sealant along with any required backer rod at all penetrations in walls, floors and ceilings for miscellaneous items such as utility piping, cables, bolts, connections, etc.

9. Apply a full bead of approved silicone sealant along with required backer rod at all penetrations of the exterior wall for miscellaneous items such as utility piping, set any exterior electrical boxes, bolts, signage connections, etc. in approved sealant for watertight application. Color shall match color of exterior wall finishes.

F. Application:
   1. Apply materials in strict accordance with manufacturer's printed directions; observe manufacturer's requirements regarding temperature control, useability of materials and protection of adjacent surfaces.
   2. Make sealing surface slightly concave, free of wrinkles and skips, uniformly smooth and with perfect adhesion along both sides of joint.
   3. Protect adjacent surfaces from excess material; leave joints in a clean, neat condition.
   4. Defective joints shall be removed, cleaned and replaced at no additional cost to the Owner.

G. Protection:
   1. Protect all finished joints for at least 24 hours.
   2. Protect from dust, moisture, and other harmful substances during installation.
   3. Do not allow silicone sealants to touch glass surfaces; all glass touched by silicone shall be replaced with clean glass.

H. Cleaning:
   1. Clean adjacent surfaces free of sealant and caulking compound or soiling; clean as work progresses.
   2. Use solvent or cleaning agent as recommended by manufacturer of sealant or caulking compound.
   3. Do not scratch or otherwise damage visible surfaces.

END OF SECTION 07 92 00

SECTION 08 11 00 – STEEL DOORS and FRAMES

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 STANDARDS

A. In addition to complying with all pertinent codes and regulations conform to latest edition of "Recommended Specifications, Standard Steel Doors and Frames, SDI 100", published by Steel Door Institute, Keith Building, Cleveland, Ohio 44115, as Architect judges them applicable and as modified herein.

B. Manufacture all labeled doors in strict accordance with the specifications and procedures of Underwriters' Laboratories, Inc., Warnock Hersey, or Factory Mutual.

C. In certifications and shop drawings, comply with nomenclature established in American National Standards Institute publication A123.1, "Nomenclature for Steel Doors and Steel Door Frames".

D. In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards or these Specifications, the provisions of the more stringent shall govern.

1.2 SUBMITTALS

A. Within 30 days of Contract date, and in accordance with requirements of Section 01 33 00, submit:

B. Shop drawings of all metal doors and frames showing dimensions, cut-outs, reinforcements, joints and welds to the Architect for review.

C. Manufacturers' technical data including certification of conformance with this specification.

1.3 QUALITY ASSURANCE

A. For installation of metal doors and frames, and installation of finish hardware, specified elsewhere, on metal doors and frames, use only personnel who are thoroughly trained and experienced in the skills required and who are completely familiar with the manufacturers' recommended methods of installation as well as the requirements of this work.

1.4 PERFORMANCE DOCUMENTATION

A. Provide documentation all doors serving as a component of the building envelope are in in compliance with Washington State Energy Code, as may be required by authorities having jurisdiction.

1.5 DELIVERY, HANDLING and STORAGE

A. Deliver, store and handle all metal doors and frames in a manner to prevent damage and deterioration.

B. Provide packaging such as cardboard or other containers, separators, banding, spreaders, and paper wrappings as required to completely protect all metal doors and frames during transportation and storage.

C. Store doors upright, in a protected dry area, at least 1" off the ground and with at least 1/4" air space between individual pieces; protect all prefinished and hardware surfaces as required.

D. Use all means necessary to protect the installed work and materials of all other trades.

E. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 – PRODUCT

2.1 GENERAL

A. All metal doors and frames specified herein shall be provided by one manufacturer.

B. Doors at fire rated openings shall be UL or NBFU certified and labeled, for minimum protection as shown on door schedule. If minimum required protection cannot be provided with openings as may be indicated, provide next higher protection (labeling) which does have required testing, approved and certified label.

2.2 MANUFACTURERS

A. Design is based on products as manufactured by Ceco Door Products. Equivalent products by Curries, Steelcraft, or S.W. Fleming (with approved primer coat), acceptable without prior approval. Other manufacturers' products must be prior approved.

2.3 METAL DOORS

A. Doors shall be made of cold-rolled steel, gauge per construction type. Doors shall be reinforced, stiffened, sound deadened and insulated with the scheduled type core completely filling the inside of the doors and laminated to both inside faces of the panels.

B. Doors shall have continuous vertical mechanical interlocking joints at lock and hinge edges with visible edge seams filled with epoxy.

C. Doors shall have beveled (1/8" in 2") lock edges.

D. Hinge reinforcing shall be 8-gauge for 1-3/4" doors.

E. Lock reinforcing shall be 16-gauge and closer reinforcing 12-gauge.

F. Adequate reinforcing shall be provided for other hardware as described in Section 08700, Hardware. All doors shall be bonderized and finished as standard with one coat of

baked-on rust inhibiting prime paint capable of passing a 500-hour salt spray and 1000-hour humidity test, in accordance with Federal Standard 141 of ASTM Specification B117, as certified by an independent laboratory.

G. Factory lites in doors with standard stop and snap-in aluminum trim to sizes as indicated in the door schedule on the Drawings.

H. Furnish all exterior doors, with snap-in vinyl top cap.

I. Glazing: Per Section 08 80 00 for glass types.

J. DOOR CONSTRUCTION TYPES

1. Type 1: Ceco Trio-E steel stiffened, polyurethane core insulated, U= 0.34 (assembly with Mercury 3 Frame), 16 gauge with all edge seams filled with epoxy. Full flush door of cold rolled steel.

2. Type 2: Ceco Legion polystyrene core insulated, 16 gauge with stitch-welded seamless edge. Full flush door of cold rolled steel.

K. Provide all Door Types with Vision lites as indicated on Door Schedule. Glass type per Section 08 80 00.

L. Provide Fire rated doors if and as scheduled.

M. Provide door, frame and adjustable stops as a single sound-rated package.

N. Labels: Where scheduled or required, provide doors with UL or WH fire resistance rating and labels for the class opening indicated or scheduled. Construction details and hardware applications authorized by labeling laboratory shall take precedence over project details or Specifications.

2.4 HOLLOW METAL FRAMES

A. Exterior frame for Door Type 1 shall be Ceco Mercury 3 Thermal Break Frames and shall be preformed of 16 gauge, cold-rolled steel, 2" faces, in depths as indicated on Drawings and as required to properly fit (the various) wall configurations. Thermal break (assembly with Trio-E door) to provide U = 0.34 energy efficiency.

B. Interior frames shall be preformed of 16-gauge, cold-rolled steel, 2" faces, in depths as indicated on Drawings and as required to properly fit (the various) wall configurations.

C. Frames shall be set up and arc welded at reinforced mitered corners (welded unit).

D. Frames for interior doors shall be supplied with factory installed rubber bumpers; 3 per strike jamb at single doors, and 2 per head for pair of doors.

E. Frames for 1-3/4" doors shall have 8-gauge steel hinge reinforcings and be prepared for 4-1/2" x 4-1/2" standard weight template hinges unless specified hardware requires otherwise.

F. Strike reinforcing shall be 16-gauge and prepared for ANSI - 115.1 Universal Strike.

G. Strike jambs shall have a 16-gauge reinforcing and be prepared for strikes as required for specified hardware.

H. Metal plaster guards shall be provided for all mortised cutouts.

I. Reinforcings for surface closers shall be 12-gauge steel. Adequate reinforcings shall be provided for other hardware as described in Section 08 70 00, Hardware.

J. Lite Frames shall match adjacent door frames or as detailed. Frames shall be furnished with a minimum of 6 wall anchors and 2 base anchors of manufacturers' standard design.

K. Grout: Unless otherwise noted on Drawings, installed interior frames shall be fully grouted with:

1. 'Gypsolite' plaster, ASTM C28-80, or approved, at interior openings in frame walls and partitions.

L. Finishes: Pre-clean and shop prime each door and frame for finish painting, as specified under Section 09 90 00 of these Specifications. Touch up shop prime before starting any finish painting.

M. All doors and frames shall be bonderized and finished, as standard, with one coat of baked-on, rust inhibiting prime paint, capable of passing a 500-hour salt spray and 1000-hour humidity test, in accordance with Federal Standard 141 or ASTM Specification B117, as certified by an independent laboratory.

N. Fire-Rated Openings: (20-minute) Fire-Rated doors shall be gasketed with a continuous resilient material on the top and two sides where the door meets the stop. Door shall be installed so that it will close with a moderate amount of pressure and remain in firm contact with the gasket. The gasket shall not interfere with self-closing function of operator/closer.

PART 3 – EXECUTION

3.1 INSPECTION

A. Prior to installation of metal doors and frames, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. Verify that metal doors and frames may be installed in strict accordance with all pertinent codes and regulations, the original design, approved shop drawings, and manufacturers' recommendations.

C. In the event of discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 INSTALLATION

A. Install all metal doors and frames in strict accordance with all pertinent codes and regulations, the approved shop drawings, and the manufacturers' recommendations, anchoring all components firmly in position for long life under hard use.

   1. Install glass at sidelites to that side of the frame on which entry is accessed unless noted otherwise or otherwise required for proper installation of window treatment.

B. **All interior hollow metal frames, including relites, shall be fully grouted.** Caulk around metal frames to adjacent wall as required and approved.

C. Finish Hardware: Install all finish hardware in strict accordance with the manufacturers' recommendations, eliminating all hinge-bound conditions and making all items smoothly operating and firmly anchored into position.

END OF SECTION 08 11 00

SECTION 08 14 00 – WOOD DOORS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 STANDARDS

A. Wood doors shall meet all applicable requirements of Architectural Woodwork Institute "Quality Standards", National Woodwork Manufacturers' Association Specifications, and National Wood Window and Door Association Standards, unless specified otherwise, and conform to Industry Standards I.S. 1-78.

1.2 SUBMITTALS

A. Within 30 days of Contract Award, and before fabrication, submit in accordance with Section 01 33 00, manufacturers' technical data on, (and samples of corner portion of) each type of door showing core, edge band, veneer and any special features.

B. Upon completion of work submit guarantee(s) as specified hereinafter.

1.3 GUARANTEES

A. All interior flush "core" type wood doors shall have a "Life of Installation" guarantee, unless otherwise specified. Provide written guarantee including repair or replacement and refinishing and rehanging costs. Warranty against warp exceeding 1/4" in any 3/0 x 7/0 section.

B. All interior stile and rail type wood doors shall bear the Manufacturer's standard 1 year repair and replacement guarantee against defects in materials and workmanship and certifying conformance with Industry Standard FHDA 7-79. Provide (additional) written guarantee to include refinishing and rehanging costs. Warranty against full depth splitting and/or warp exceeding 1/4" in any 3/0 x 7/0 section.

1.4 DELIVERY, HANDLING AND STORAGE

A. Before delivering doors to site, seal all edges with an approved clear sealer, compatible with painter's finish specified; protect doors during delivery and while stored on the job. Store in dry location and protect from weather.

PART 2 – PRODUCT

2.1 APPROVED MANUFACTURERS

A. Flush Doors: Lynden Door, Vancouver Door, Haley, or Marshfield Door Systems, Inc. Others may be (prior) approved, under procedures outlined in Division 1, subject to meeting specified and detailed requirements. The entire latest published specification of the named manufacturer shall hereby become a part of this Specification.

2.2 MATERIALS

A. Vision Lite Frames: Shall be 18-gauge, cold rolled steel, sizes as required for visible glass area indicated on door code list. Corner and intersections shall be smoothly mitered, welded and ground smooth, prime coated to be painted per Section 09900. Fasten with countersunk oval head screws or set bolts.

B. Glazing: Per Section 08800 for glass types.

C. Wood Door Types:

1. Door Type 3 - Flush, 1¾" solid particle board core, with solid wood edge frame and HPVA Architectural "A" Grade wood veneer (Maple) based on Lyden Door, LD2000 PC-5.

a. Factory Finished from Lynden Door "Pacific Collection", color as selected by Architect.

PART 3 – EXECUTION

3.1 FABRICATION

A. Refer to Door Schedule for types, ratings, labels, sizes and details. Obtain templates for all hardware and accessories. Provide cutouts for lites and grilles, (louvers) and prepare for hardware as scheduled.

B. Pre-hanging/assembly of fire-rated units shall be done only by properly certified fabricator, and assembled units shall be approved as meeting required rating.

3.2 INSTALLATION

A. Protect doors as recommended by manufacturer. Install specified hardware and hang. Fit doors to provide 1/16" to 1/8" clearance at jambs and heads or as required for labeled openings. Bevel strike stiles as required for clearance. Ease all edges of doors. Maximum clearance at floor shall be 1/4" clear of finish surface (verify carpet thickness, etc.,) unless otherwise indicated.

B. All doors and hardware shall be adjusted as required and shall be in perfect working order at time of acceptance of the complete project.

END OF SECTION 08 14 00

SECTION 08 36 00 – SECTIONAL OVERHEAD DOORS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 STANDARDS

A. ANSI/DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors.

1.2 SUBMITTALS

A. Within 30 days of Contract Date, and in accordance with provisions of Section 01 33 00, submit:

1. Manufacturers' Data: Complete manufacturers' literature on the proposed overhead sectional doors for review by the Architect.

2. Manufacturer shall provide 5 year "factory published" warranty.

3. Shop Drawings: Verify all dimensions by taking field measurements before submitting shop drawings to the Architect; proper fit and attachment to adjoining work is required. Shop drawings shall be submitted per GENERAL CONDITIONS and DIVISION 1, which show sizes, methods of construction, connection to adjacent members, weatherstripping and installation.

1.3 DESIGN PERFORMANCE REQUIREMENTS

1. Wind Loads: Design and size components to withstand loads caused by pressure and suction of wind acting normal to plane of wall as calculated in accordance with applicable code. Minimum design pressure of 20 psf (allowable). A maximum 1/120 of door width deflection with door in horizontal position.

   a. Wiring Connections: Requirements for electrical characteristics: 115 volts, single phase, 60 Hz.

2. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.

1. Installers: Use only personnel who are thoroughly trained and experienced in installation of the selected products, who are completely familiar with the requirements of this Work, and who are approved installers by the manufacturer.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

D. Coordination: Coordinate and schedule the work of this Section with other trades for coordination and connection of electrical power requirements and locations, anchorage locations, trim, etc. as required for a complete and operable system.

1.5 DELIVERY, HANDLING AND STORAGE

A. Deliver, handle and store all special doors and tracks in a manner to prevent damage and deterioration. Use all means necessary to protect special doors before, during and after installation and to protect the installed work and materials of all other trades.

B. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 – PRODUCT

2.1 MANUFACTURER

A. All overhead doors, track and motor operators shall be the products of one manufacturer. Design is based on Overhead Door Company, products by other manufacturers must have prior approval.

2.2 DOOR CONSTRUCTION TYPE

A. Door Type 4 – Insulated Sectional Overhead Doors.

2.3 INSULATED SECTIONAL OVERHEAD DOORS

A. Insulated Steel Sectional Overhead Doors: 591 Series Thermacore Door Systems Insulated Sectional Doors by Overhead Door Corporation. Units shall have the following characteristics:

B. Door Assembly: Insulated steel door assembly with rabbeted meeting rails to form weathertight joints and provide full-width interlocking structural rigidity.

1. Panel Thickness: 1-5/8” inches

2. Insulation: CFC-free polyurethane core

3. R-Value: 14.85 (U-0.13)

4. Exterior Steel: 0.15” hot-dipped galvanized roll-formed steel

5. Thermal Break: PVC

6. Exterior Color: To be selected from manufacturer's standard colors

7. Interior Color: White

8. Springs: 10,000 cycles

C. Hardware: Galvanized steel hinges and fixtures. Ball bearing rollers with hardened steel races.

D. Lock: Interior slide lock.

E. Weather stripping:

1. Bottom: Flexible bulb-type strip at bottom of section.

2. Flexible Jamb seals.

3. Flexible Header seal.

4. Between Sections: PVC thermal break with section steel

F. Track: Provide track as recommended by manufacturer to suit loading required and clearances available.

G. Manual Operation: Chain Hoist

H. Electric Motor Operation: Provide UL listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second. Operator shall meet UL325/2010 requirements for continuous monitoring of safety devices. RSX standard duty electric commercial operator or equal, not less than ½ horsepower.

1. Entrapment Protection: Required for momentary contact.

a. Photoelectric sensors monitored to meet UL 325/2010.

2. Operator Controls:

a. Push-button operated control stations with open, close, and stop buttons.

b. Surface mounting, interior location

PART 3 – EXECUTION

3.1 INSTALLATION

A. Inspection: Prior to installation of doors, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

1. Verify that garage doors may be installed in strict accordance with all pertinent codes and regulations, the original design, reviewed shop drawings, and manufacturers' recommendations.

2. In the event of discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

B. Installation of Doors: Install all overhead doors in strict accordance with all pertinent codes and regulations, the reviewed shop drawings, and the manufacturers' recommendations, anchoring all components firmly in position for long life under hard use. Align for proper fit on all sides. Caulk with specified general purpose sealant around all metal frames to adjacent wall surface; color as selected.

1. Install all finish hardware in strict accordance with the manufacturers' recommendations, making all items smoothly operating and firmly anchored into position.

3.2 CLEANING AND ADJUSTING

A. Adjust door assembly to smooth operation and in full contact with weather stripping.

1. Test operation and alignment of doors, make all necessary adjustment and leave in proper, smoothly operating and tight fitting condition.

B. Clean doors and frames.

C. Remove temporary labels and visible markings.

3.3 PROTECTION

A. Do not permit construction traffic through overhead door openings until after adjustment and cleaning.

B. Protect installed products until completion of project.

C. Touch-up, damaged coatings and finishes and repair minor damage before Substantial Completion.

END OF SECTION 08 36 00

SECTION 08 51 13 – ALUMINUM WINDOWS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUBMITTALS

A. Within 30 days on Contract date, and per GENERAL CONDITIONS and Section 01 33 00, submit:

1. Shop Drawings of all specified work showing sizes, methods of construction, connection to adjacent members and installation.

2. Samples of specified materials and required finishes. Obtain review comments before start of fabrication.

1.2 QUALITY ASSURANCE

A. Guarantee

1. Guarantee all finish metal work for five (5) years.

2. Aluminum windows shall be free from material defect in materials and workmanship for a period of two (2) years.

B. Installer Qualifications: An installer which has had successful experiences with installation of the same or similar units required for this project and other projects of similar size and scope.

C. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.

D. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

1.3 PERFORMACE LABELING

A. Fenestration manufacturer shall provide a NFRC bid report showing the specified system meets the requirements of the Washington State Energy Code.

B. Air infiltration maximum rate for operable shall be .3 cfm/sf at 6.2 psf and for fixed shall be .1 cfm/sf at 6.2 psf.

1.4 DELIVERY, HANDLING and STORAGE

A. Protect materials from scratches and staining. Store materials in location safe from damage by other trades. Protect material once it is placed from damage from other trades until acceptance by Owner.

1.5 JOB CONDITIONS

A. Measurements: Verify all dimensions by taking field measurements; proper fit and attachment of all component parts is required.

B. Coordination: Coordinate work and scheduling of the work of this Section with other trades for coordination of size of reveals, locations of anchorage, etc.

PART 2 – PRODUCT

2.1 MANUFACTURER

1. For purposes of designating type and quality of work of this Section, Drawings and Specifications are based upon products of Kawneer Company, Inc. Whenever substitute products are to be considered, supporting technical literature, samples, drawings and certified performance data must be submitted in order to make a valid comparison of the products involved.

2. Equal Products by Oldcastle or Arcadia may be substituted, subject to shop drawing approval. Other manufacturers must be prior approved.

2.2 PRODUCTS

A. Aluminum Windows (Fixed): Kawneer AA5450 Ultra Thermal Fixed (standard face) Window with an AW-PG70-FW or higher designation, including receptor (head and jambs) and sub sill for interior installation, perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of window units.

B. Aluminum Windows (Sliding): Kawneer AA5450 Ultra Thermal Horizontal Sliding (standard face) Window with an AW-PG40-HS or higher designation, including receptor (head and jambs) and sub sill for interior installation, perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of window units.

2.3 MATERIALS

A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" wall thickness at any location for the main frame and sash members.

B. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.

C. 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.

D. Reinforcing Members: Aluminum, 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.

E. Hardware (horizontal sliding windows): Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash weight and dimensions. Provide the following operating hardware:

1. Handle: Continuous, integral pulls.

2. Sash Locks.

3. Composite adjustable tandem roller.

4. Stainless Steel roller track.

5. Standard auto lock.

6. Limit device.

F. Insect Screens (horizontal sliding windows): Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on outside of window and provide for each operable exterior sash.

1. Comply with SMA 1004, "Specifications for Aluminum Tubular Frame Screens for Windows," for minimum standards of appearance, fabrication, attachment of screen fabric, hardware, and accessories unless more stringent requirements are indicated.

G. Aluminum Insect Screen Frames (horizontal sliding windows): 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.

1. Extruded-Aluminum or Aluminum Tubular Framing Sections and Cross Braces: Not less than 0.050-inch (1.3-mm) wall thickness.

2. Finish: Manufacturer's standard.

H. Aluminum Wire Fabric (horizontal sliding windows): 18-by-16 mesh/inch (18-by-16 mesh/25.4mm) of 0.011-inch- (0.28-mm-) diameter, coated aluminum wire.

1. Wire-Fabric Finish: Charcoal Grey or Natural Brite-Kote as selected by Architect.

I. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

J. Finish: All exposed members shall be free of scratches and other noticeable surface blemishes. Factory finish to conform to Aluminum Association Standard AA-

M10C21A41, AAMA 611 Architectural Class 1 clear anodic coating #14. Permanodic finish shall be obtained on all exposed aluminum sections by buffing and etching followed by an anodic treatment to produce a high density aluminum oxide coating.

K. Glazing: As shown on the Drawings, and specified in Section 08 80 00.

1. Glazing method shall be a wet/dry type in accordance with manufacturer's standards. Exterior glazing shall be silicone back bedding sealant. Interior glazing shall be snap-in type glazing beads with an interior gasket in accordance with AAMA 702 or ASTM C864.

L. Anti-Corrosion Isolation Materials: Zinc chromate primer on butyl rubber tape, as appropriate to conditions.

PART 3 – EXECUTION

3.1 FABRICATION

A. 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 fit joints; make joints flush, hairline and weatherproof.

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.

7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

B. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

C. Fabricate aluminum windows that are re-glazable without dismantling sash or framing.

D. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact. Thermal barriers shall be designed in accordance with AAMA TIR A8.

1. Frame thermal barrier shall be polyamide with a minimum of 1" (25.4 mm) separation, installed continuously and mechanically bonded to the aluminum.

2. Sash thermal barrier shall be polyamide with a minimum of 1/2" (12.7 mm) separation, installed continuously and mechanically bonded to the aluminum.

E. Weather Stripping: Provide full-perimeter weather stripping for each operable sash.

F. Weep Holes: Provide weep holes and internal passages in window frames to conduct infiltrating water to exterior.

G. Provide water-shed members as required above lines of natural water penetration.

H. 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.

I. Sub frames: Provide sub frames with anchors for window units as shown, of profile and dimensions indicated but not less than 0.093-inch (2.4-mm) thick extruded aluminum. Miter or cope corners, and join with concealed mechanical joint fasteners. Finish to match window units. Provide sub frames capable of withstanding design loads of window units.

J. Factory-Glazed Fabrication: Contractor's option to glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 08 80 00 Section "Glazing" and with AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS).

K. Glazing Stops: Provide snap-on glazing stops coordinated with Division 08 Section "Glazing" and glazing system indicated. Provide glazing stops to match frame.

L. Performance: Aluminum framing shall meet or exceed the following performance requirements:

1. Air Infiltration Test: Conduct test in accordance with ASTM E 783 at a minimum uniform static test pressure of 1.57 psf (75 Pa) for CW or 6.24 psf (300 Pa) for AW. The maximum allowable rates of air leakage for field testing shall not exceed 1.5 times the project specifications.

2. Water Infiltration Test: Water penetration resistance tests shall be conducted in accordance with ASTM E 1105 at a static test pressure equal to 2/3 the specified water test pressure.

3. Glazing assemblies shall be certified and labeled in accordance with U-factor and solar heat gain coefficient by an independent agency certified by NFRC. Assembly U-valves shall meet or exceed the prescriptive valves shown on the drawings.

M. Glazing: As scheduled (on Drawings), and specified in Section 08800.

3.2 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install aluminum framed storefront system level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weather tight construction.

D. Install aluminum framed storefront system and components to drain condensation, water penetrating joints, and moisture migrating within sliding door to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 CLEAN UP

A. Adjust operating sashes, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weather tight closure. Lubricate hardware and moving parts.

B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean 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 08 43 00

SECTION 08 70 00 – FINISH HARDWARE

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of finish hardware is shown on the Drawings and in the schedules. Finish hardware is hereby defined to include all items known commercially as builder's hardware as required for swing doors, (sliding doors, etc.) except certain special types of hardware specified in the same section as the door and/or door frame.

B. Hardware, which is part of the following articles, as well as separate items of hardware listed below, are not included in this Section of the Specifications.

1. Cabinet hardware, fastenings, brackets and other hardware specified to be, (or customarily), furnished with special doors, gates, specialty items, etc.

1.2 SUBMITTALS

A. Conform to Section 01 33 00, SUBMITTALS, and further requirements as follows:

1. Hardware supplier shall submit required number of copies of a complete hardware schedule, in a vertical format, for the Architect's approval. Hardware for **each door** shall be separately listed in numerical order. List hardware symbols opposite each item. Schedules prepared in a horizontal coded form will not be accepted.

2. Submittal(s) shall include manufacturers' catalog 'cuts' covering all significant data on all items other than the exact (manufacturers' number) items specified herein. If approved, requested copies will be returned.

3. Corrections or changes in the first submittal must be incorporated promptly and the required number of copies of the revised schedule returned to the Architect.

4. Hardware schedules are intended for coordination of the work. Review and acceptance by the Architect or Owner does not relieve the Contractor of his responsibility to fulfill the requirements as shown and specified. Provide additional copies to the General Contractor to meet his requirements.

5. Include a copy of Schedule showing **exact** final installation in the Operating Instructions and Maintenance Manual for general work.

1.3 QUALITY ASSURANCE

A. Acceptable Manufacturers and their product numbers are specified herein. Others must be named in Addenda.

1. Subcontract for the furnishing of hardware, as specified herein, shall be by well recognized builders' hardware supplier who has been furnishing hardware in the

same area as the Project for a period of not less than 2 years and who has in his employment an experienced hardware consultant who is available at all reasonable times during the course of the Work for Project hardware consultation to the Owner, Architect and Contractor.

1.4 GUARANTEE REQUIREMENTS

A. In addition to requirements of the GENERAL CONDITIONS, also guarantee that repair service and replacement parts for all items specified herein, shall be available from local sources. See certain items following for additional specific guarantee requirements.

PART 2 – PRODUCT

2.1 MANUFACTURERS

A. The numbers shown in the Hardware Groups are taken from the catalogs of the following manufacturers and are for the purpose of establishing quality, design, function and finish. Except as listed, no substitutions will be allowed, except in strict accordance with procedures specified. The Architect may require that requests for approval of items other than shown be accompanied by physical samples of items proposed for substitution.

Item	Numbers Used	Approved Substitutions
Butts	Stanley	Hager, McKinney, Ives
Panic Devices & Trim	Precision	Accentra, Von-Duprin
Electric Strikes	Von-Duprin	HES, Adams-Rite
Door Position Switches	Securiton	None
Cylinders	Best	None
Locks/Latchsets	Best	None
Closers	Norton	None
Wall/Floor Stops	Ives	Hager, Rockwood
Push/Pull Plates	Ives	Hager, Rockwood
Flush Bolts	Ives	Hager, Rockwood
Thresholds	Pemko	Zero, Hager
Sweeps	Pemko	Zero, Hager
Door Seals (Gaskets)	Pemko	Zero, Hager
Meeting Strips/Astragals	Pemko	Zero, Hager

2.2 FINISHES

A. Unless specifically indicated otherwise, architectural hardware items shall be furnished in the following finishes:

B. Butts, locks, latchsets, door stops and miscellaneous items: satin chrome plated (US 26D)

C. Exit Devices: satin stainless steel (US32D/630)

D. Push and Pull Plates: satin stainless steel (US32D).

E. Door Closers: Aluminum lacquer 689

F. Plastic Kickplates: Color as selected by the Architect.

2.3 KEYING FOR BUILDING LOCKS

A. Cylinder housing and cores to be provided, keyed, and installed by the Owner.

B. Any locks installed during the normal period of construction shall be temporary locks, or if permanent, without permanent cylinder cores or keys. All secure doors must be operative for access and exit during construction with construction locks or cores.

2.4 BUTTS

A. All butts shall have concealed bearings.

B. Provide non-removable pins (NRP) for all exterior doors and for reverse bevel, interior, lockable doors.

C. Width of butts shall be as required to clear projecting trim or structural conditions to obtain maximum degree of opening.

D. Provide: 1-1/2 pair butts for doors from 61" to 90" in height

E. Provide: One extra butt for every 30" exceeding 90" in height.

2.5 LATCH AND LOCKSETS

A. Lever Lockset Design: Shall be Best 14C.

B. Provide Escutcheons for mortise locks at wood doors, as required. Best 14C.

C. Provide all Locks and Deadbolts with wrought box strikes.

1. Dead bolts shall be of the mortise type, unless otherwise specified, with one or two cylinders as indicated by function requirements and provided with hardened steel bolts or bolts having hardened steel inserts.

D. In addition to guarantee requirements specified above, locks shall carry a 1 year guarantee of satisfactory performance.

2.6 DOOR CLOSERS

A. Arms shall permit maximum degree of opening permitted by wall conditions. All closers shall function in conformance with current Federal (HEW) Handicapped Access Requirements; including hold open time and maximum allowable horizontal force required to operate.

B. Furnish all closers on exterior doors with heavy duty (EDA) arms.

C. Provide through bolts for application to (mineral core) doors.

D. Furnish closers with key valves for speed, latching and back checking adjustments.

E. Provide drop plates for doors with insufficient top rails to cover sight of closers from opposite side of door, and when used in conjunction with regular arm closer and overhead concealed stop application.

F. Closers shall be applied to both leaves of a pair of doors unless noted otherwise.

G. In addition to guarantee requirements specified above, provide Owner with a 5-year performance guarantee, for closers.

2.7 DOOR STOPS AND SILENCERS

A. Types are listed in hardware schedule.

B. Provide floor stops of proper type and height to suit door clearance.

C. Provide toggle bolts or machine screws and tamp-ins as required. Plastic or fiber anchors will not be permitted.

D. Provide door silencers at all openings not scheduled to receive perimeter weatherstripping or gasketing. Rubber insert type proper for application, as approved.

2.8 ADDITIONAL RELATED REQUIREMENTS

A. Provide the following additional hardware items:

1. Furnish all thresholds with stainless steel machine screws and lead anchors. Thresholds shall be set in caulking compound.

2.9 HARDWARE GROUPS

GROUP NO.	ITEMS REQ'D	MANUFACTRER NO.	REMARKS
HW-1	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Passage Lever	9K3 N 14C S3	626
	Closers	8501 TRI-PACK	689
	Gasket	S88D	D.BRN
HW-2	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Privacy Lever	9K3 L 14C S3	626
	Closer	8501 Tri-Pack	689
	Wall Stop	WS406	26D
HW-3	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Entry Lock	9K3 7 AB 14C S3	626
	Closer	8501 Tri-Pack	689
	Gasket	S88D	D.Brn
HW-4	Hinges	FBB199 4.5" x 4.5" NRP	26D

	Entry Lock	9K3 7 AB 14C S3 (active leaf only)	626
	Closer	CPS 8501 (active leaf only)	689
	Flush Bolts (top/bot.)	FB458 12" (inactive leaf only)	26D
	Sweeps	315CN36"	Alum
	Threshold	172A72"	Alum
	Astragal	3572 84"	Alum
	Gasket	S88D	D.Brn
HW-5	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Storeroom Lock	9K3 7 D 14C S3	626
	Closer	CPS 8501	689
	Electric Strike	6211 24 vdc	630
	Door Position Switch	DPS - M - BK	Black
	Sweep	315CN36"	Alum
	Threshold	172A36"	Alum
	Gasket	S88D	D.Brn
HW-6	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Entry Lock	9K3 7 AB 14C S3	626
	Closer	CPS 8501	689
	Sweep	315CN36"	Alum
	Threshold	172A36"	Alum
	Gasket	S88D	D.Brn
HW-7	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Entry Lock	9K3 7 AB 14C S3 (active leaf only)	626
	Closer	8501 Tri-Pack (active leaf only)	689
	Flush Bolts (top/bot)	FB458 12" (inactive leaf only)	26D
	Meeting Strips	18041CNB84"	Alum
	Gasket	S88D	D.Brn
HW-8	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Passage Lever	9K3 N 14C S3	626
	Wall Stop	WS404CVX	26D
HW-9	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Storeroom Lock	9K3 7 D 14C S3	626
	Closer	8501 Tri-Pack	689
	Electric Strike	6211 24 vdc	630
	Door Position Switch	DPS - M - BK	Black
	Wall Stop	WS404CVX	26D
HW-10	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Exit Lock	9K3 7 YD 14C S3	626
	Closer	CPS 8501	689
	Door Position Switch	DPS - M - BK	Black
	Sweep	315CN36"	Alum
	Threshold	172A36"	Alum
	Gasket	S88D	D.Brn

HW-11	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Entry Lock	9K3 AB 14C S3	626
	Wall Stop	WS404CVX	26D
HW-12	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Entry Lock	9K3 7 D 14C S3	626
	Electric Strike	6211 24 vdc	630
	Door Position Switch	DPS - M - BK	Black
	Closer	8501 Tri-Pack	689
	Gasket	S88D	D.Brn
	Wall Stop	WS404CVX	26D
HW-13	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Entry Lock	9K3 AB 14C S3	626
	Closer	8501 Tri-Pack	689
	Wall Stop	WS404CVX	26D
HW-14	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Rim Panic Device	2103 CD	630
	Locking Panic Trim	4903A	630
	Electric Strike	6211 24 vdc	630
	Door Position Switch	DPS - M - BK	Black
	Closer	CPS 8501	689
	Threshold	172A36"	Alum
	Sweep	315CN36"	Alum
	Gasket	S88D	D.Brn
HW-15	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Rim Panic Device	2103 CD	630
	Locking Panic Trim	4903A	630
	Electric Strike	6211 24 vdc	630
	Door Position Switch	DPS - M - BK	Black
	Closer	CPS 8501	689
	Wall Stop	WS404CVX	26D
HW-16	Hinges	FBB199 4.5" x 4.5" NRP	26D
	Rim Panic Device	2103 CD EO	630
	Door Position Switch	DPS - M - BK	Black
	Closer	CPS 8501	689
	Threshold	172A36"	Alum
	Sweep	315CN36"	Alum
	Gasket	S88D	D.Brn

HW-17 See Specification Section 13 21 26 for cooler door hardware.

HW-18 See Specification Section 08 36 00 for sectional overhead door hardware.

PART 3 – EXECUTION

3.1 PRODUCT HANDLING

A. Provide secure lockup for hardware delivered to the Project, but not yet installed. Control the handling and installation of hardware items which are not immediately replaceable so that the completion of the work will not be delayed by hardware losses, both before and after installation.

3.2 COORDINATION

A. Coordinate Hardware with other Work: Tag each item or package separately, with identification related to the final hardware schedule; include basic installation instructions in the package. Furnish hardware items of proper design for use on doors and frames of the thicknesses, profile, swing, security, and similar requirements indicated, as necessary for proper information in the Contract Documents. Deliver individually packaged hardware items at the times and to the locations (shop or field) for installation, as directed by the Contractor.

B. Templates: Furnish hardware templates to each fabricator of doors, frames, and other work to be factory-prepared for the installation of hardware. Upon request, check the shop drawings of such other work, to confirm that adequate provisions will be made for the proper installation of hardware.

1. Have templates available not more than 10 days after receipt of approved hardware schedule.

3.3 HARDWARE MOUNTING HEIGHTS

A. In the absence of a hardware installation requirement in another Section of this Specification, the following recommendations shall be used as a guide:

1. Top Hinge: 5" header rabbet to top of hinge.

2. Bottom Hinge: 10" finish floor to bottom hinge

3. Center Hinge: Equal distance between top and bottom hinges

4. Latch/Locksets: 40" finish floor to center lever (or as required by exit device requirements)

5. Deadlocks/Deadlatches: 54" finish floor to center of cylinder

6. Exit Devices: 41" finish floor to top of housing or (except): mounting 39" finish floor to top of housing or mounting at doors containing handicapped accessible vision lites.

7. Push Plates:42" finish floor to center of plate

8. Door Pulls:42" finish floor to center of pull

9. All other hardware shall be installed as recommended by the manufacturers.

3.4 INSTALLATION

A. Install each hardware item in compliance with the manufacturers' instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, install each item completely and then remove and store in a secure place during the finish application. After completion of the finishes, reinstall each item. Do not install surface-mounted items until finishes have been completed.

3.5 ADJUSTMENT AND CLEANING

3.6 Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Lubricate moving parts with type lubrication recommended by manufacturer (graphite type if no other recommended). Replace units which cannot be adjusted and lubricated to operate freely and smoothly as intended for the application made.

3.7 All doors, when installed and ready for use, shall function in conformance with current Federal (HEW) Requirements for Handicapped Access; including hold open time and maximum allowable horizontal force required to open. Adjust all hardware as required.

3.8 Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make a final check and adjustment of all hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

3.9 Instruct Owner's personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware, or scheduled Owner's instruction session, per DIVISION 1, as directed.

END OF SECTION 08 70 00

SECTION 08 80 00 – GLASS and GLAZING

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 STANDARDS

A. Comply with all applicable standards of the Flat Glass Jobbers Association's Glazing Manual. Tempered or safety glass, as approved, where required by codes, ordinances or federal regulations and standards.

B. Each piece of glazing shall bear manufacturer's label certifying type and grade. Do not remove labels until approved by Architect.

1.2 SUBMITTALS

A. Within 30 days of Contract date, and per Section 01 33 00, submit:

1. 6" min. square samples of each specified glass type. Have each sample bear manufacturers' label, material identification and use destination. All samples shall be banded to prevent sharp edges.

1.3 GUARANTEE

A. Guarantee all glass and glazing for a period of 2 years. All insulating glass shall be guaranteed for 10 years against seal failure.

1.4 JOB CONDITIONS

A. Measurements

1. Verify all glass dimensions by taking field measurements before any glass is shipped to job site.

B. Coordination

1. Coordinate work with components to be glazed to prevent delay in work.

C. Inspection

1. Examine all subsurfaces to receive work of this Section and verify that they are in proper condition to commence work of this Section.

D. Delivery, Handling and Storage

1. Deliver and store materials in protected areas. Protect glass, whether installed or not, against damage; replace broken or defective glass at no cost to Owner.

PART 2 – PRODUCT

2.1 MANUFACTURER

A. Vitro Architectural Glass (formerly Pittsburg Plate Glass Co.), Libby Owens Ford Glass Co., American Saint Gobain Corporation, Environmental Glass Products, Rohm & Haas, or as approved by Architect.

2.2 MATERIALS

A. Glazing Types:

1. Type 1: 1/4" clear float, tempered where required by current code and regulations.

2. Type 2: Factory (shop) fabricated 1" insulating Glass Unit, formed from 2 lites of Type I, Quality-Q3, 1/4" glass; Vitro Solarban 60 (#2 surface) on 6mm Solarbronze, Air 10%/Argon 90% mix, 1/2" spacer, 6mm clear inboard. All exterior lites to be Heat-Strengthened and interior lites annealed, except where Fully Tempered Safety Glass is mandated by code.

   a. Visible transmittance = 42%, exterior visible reflectance = 7%, interior visible reflectance = 11%, U-value (winter/nighttime) = 0.24, and solar heat gain coefficient (SHGC) = .27.

3. Factory (shop) fabricated 1" insulating Glass Unit, formed from 2 lites of Type I, Quality-Q3, 1/4" glass; 6mm clear, Air 100%, 1/2" spacer, 6mm clear inboard, both lites Fully Tempered.

   a. Visible transmittance = 79% minimum.

B. Setting Blocks: Hard rubber or clear grain softwood.

C. Sealants: High performance, 1 part Silicone based sealant; Dow Corning 999-A, General Electric "SILPRUF', Tremco 'Spectrum 2', or as approved by Architect; color as selected. Include primer as recommended by manufacturer, where required.

D. Putty: Conforming to Federal Specification TT-P-791Z, Type 1.

E. Glazing Gaskets: Appropriately sized and shaped for the application and as manufactured by Conservation Technology or equal manufacturer, extruded EPDM; free of porosity, surface defects, dimensional irregularities and conforming to physical properties of ASTM C502.

F. Glazing Tape: DAP #1202, or as approved.

2.3 FABRICATION

A. Insulating glass units shall be fabricated in a fully equipped commercial fabrication shop and only by skilled workmen thoroughly familiar with all materials and well experienced in the processes involved.

B. All glass shall be **machine washed** prior to assembly of insulating units.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Do no glazing in damp or rainy weather.

B. Have surfaces receiving glass clean, dry and free of foreign matter. Prepare, clean and prime (as required), surfaces to which sealant is to be applied, per sealant manufacturers' recommendations.

C. Install glass glazing types at locations shown on Drawings and according to glass manufacturer's recommended maximum size limitations and placement of any setting blocks. Make all adjacent glass in same glazed areas consistent in type and thickness, unless otherwise noted, directed, or required by code.

D. Keep labels indicating manufacturer, quality and thickness on glass until installation has been approved by Architect. Absence of label constitutes cause for rejection.

3.2 PROTECTION and CLEANING

A. On completion of work and just prior to job completion date, clean and wash all glass thoroughly. Use no abrasives, implements or methods likely to result in scratched surfaces. Replace any scratched, defective or broken glass caused by improper.

END OF SECTION 08 80 00

SECTION 09 21 16 – GYPSUM WALLBOARD

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 STANDARDS

A. Comply with all applicable requirements of "American Standard Specifications for the Application and Finishing of Gypsum Wallboard", by the American Standards Association, except where more stringent requirements are called for herein, in local codes, or by manufacturer of materials.

1.2 SAMPLES

A. Prepare and submit successive groups of two identical samples of surface texture(s) as required and directed and obtain Architect's approval before proceeding with texturing. Samples shall be a minimum of 2-feet square pieces of same type(s) wallboard used in the work, prime sealed and painted as specified. Approved sample(s) shall be retained as criteria for approval of finished work.

1.3 QUALITY ASSURANCE

A. Employ only qualified journeymen mechanics in this work; apprentices may be employed on the work under the direction of qualified journeymen in accordance with trade regulations.

B. Conform particularly to code requirements to achieve fire ratings of walls, ceilings, etc., which require joint taping or surfacing of gypsum assemblies, even when finishing is not required for decorative purposes.

C. Provide temporary coverings and coordinate work, as required so that adjacent surfaces are protected from materials and operations specified in this Section.

1.4 COORDINATION

A. Work herein requires coordination with trades whose work connects with, is concealed by, or is affected by, gypsum wall and ceiling finishing. Schedule this work to not cover incomplete or uninspected work. Redo work which must be removed due to premature concealment of work of other trades.

B. Advise all trades of requirements and conditions that their work must meet in order to obtain the best quality of gypsum wallboard finishing.

1.5 JOB CONDITIONS

A. Ventilation: Do not proceed with joint taping and finishing until the interior is enclosed adequately to control ventilation and circulation in conjunction with temporary heat, to achieve stabilization of framing and proper drying, setting and curing finishing compounds.

B. Lighting: Do not proceed with the work in any room unless lighting level of 15 candlepower per square foot is available.

PART 2 – PRODUCT

2.1 MATERIALS

A. Gypsum Wallboard: USG, or equal products by Gold Bond or Georgia-Pacific, Conforming to ASTM C36-77. 4' x 8' or 10' sheets thicknesses as noted on Drawings. Standard type, **except**:

1. Use Type "X" Gypsum Wallboard where noted or scheduled on Drawings, or required for fire rated assemblies indicated.

2. Use Moisture Resistant (MR) type Gypsum Wallboard for non-rated construction at restrooms and shower areas, and elsewhere as noted or scheduled on Drawings.

3. Use "Interior Gypsum Ceiling Board" sag-resistant panels at all interior ceilings and soffits.

B. Screws: USG, or equal, Type S, of length proper for conditions.

C. Nails: Cement coated, of lengths as required.

D. Gypsum Wallboard Accessories: 26-gauge, USG.

1. "J" Mold - 200 Series, ½" x 5/8" , tape in metal edge protection.

2. "J" Trim (Stop) - #402, 5/8" or #401, ½" exposed metal edge reveal.

3. Corner Bead – USG Dur-A-Bead #800, tape in metal corner protection

4. Casing Bead – USG Expanded flange corner bead, #801A, corner protection.

5. Control Joint – USG zinc control joint #93, tape in drywall expansion joint.

6. Others - As required.

E. Joint Compound and Tape: Typically, USG's "Dura-Bond" and "Perf-a-Tape or equal. Fiberglass mesh tape and adhesive at WR board locations.

F. Gypsum Wallboard Primer: ASM approved PVA product(s).

G. Texturing Material: USG "Perf-a-Tape" all purpose joint compound, diluted to slurry consistency as required to produce texture as approved by Architect.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect surfaces and conditions before starting work and verify they are in proper condition to commence work of this Section. Do not proceed until improper conditions are corrected.

3.2 INSTALLATION

A. Gypsum Board Installation: Conform strictly to applicable requirements of the Standard Specifications. Screw apply board to metal framing; if option is used, nail board at wood framing. Maximum attachment spacing 12" o.c. Install metal corner reinforcement at all external corners. Install J molding, or trim where called for, at all exposed drywall edges or edges at dissimilar materials

1. Where ceilings abut differing wall materials, install approved metal edge trim with applied vinyl insert or minimum 1/2" self-adhesive weatherstripping. Conceal flange of metal trim reinforcement with at least 2 coats compound.

a. Control joints shall be installed as noted on drawings and where a wall or partition runs in an uninterrupted straight plane exceeding 30 linear feet. Control joints in direct-applied interior ceilings without perimeter relief shall be installed so that linear dimensions between control joints do not exceed 30 feet. Control joints hall be provided at every overhead door jamb from top of door to ceiling (each side).

B. Gypsum Wallboard Taping and Finishing: Apply embedding or all-purpose compound to dimples at fastener heads, marred spots and joints in gypsum wallboard surfaces that are to receive further painting, coatings, or wallcovering finishes, or that are required to be taped for fire ratings, code requirements or sound control. Center tape over joint and embed in uniform layer of joint compound of sufficient width and depth to provide firm and complete bond. Apply skim coat while embedding tape.

1. Finish joints with a sufficient number of coats of compound, sanded or sponged as required, to achieve a monolithic surface without ridges, protrusions, dents or other visible imperfections in the surface, ready to receive specified surface finish.

C. Attachment and Finishing to Trims: Provide trims as specified, detailed and noted on the Drawings and install to best suit the conditions of the work. Trims requiring finishing with joint compound shall be filled and subsequently finished to meet the finish requirements of the gypsum wallboard joints. Trims that are adhesively attached with tape compounds are specifically included in this Section.

1. Conceal flanges of metal reinforcement with at least 2 coats compound. When completed, compound shall extend approximately 8" to 10" on each side of metal nosing.

2. Provide all exposed fastener heads with sufficient coats of joint compound and sand as necessary to completely conceal trim.

D. Taping not required on gypsum wallboard surfaces that are above ceilings, behind acoustic tile, in concealed spaces, behind rigid surface paneling or on base layers of multi-layer systems, except as required for fire resistance ratings; on draft stops in attic

spaces; under ceramic tile on water resistant board or tile backer types of gypsum wallboard; and where tongue and groove edged backer board is installed to achieve fire resistance ratings for the assembly as installed.

E. Moisture in Dry-Type Compounds: Allow coats of taping and finishing compounds which achieve their bond, strength, and hardness through drying (as opposed to chemical setting), to dry to a maximum of 15% moisture content before subsequent coats or finishes are applied.

3.3 TEXTURING

A. Prior to application of texturing material, all gypsum surfaces (to receive texturing) shall be "sealed" with PVA, or approved, as recommended by texturing material manufacturer and Architectural Specifications Manual and as described in Section 09 91 00.

B. All new GWB walls shall receive spray texture as specified herein except:

1. Surface permanently concealed from view (as above suspended ceilings, etc.).

2. Surfaces scheduled for 'Fire-Taping' only.

3. Surfaces scheduled to be finished with ENAMEL.

4. Surfaces scheduled to receive wall fabric, ceramic tile, or other wainscoting.

C. Walls and ceilings to have light to medium "orange peel" (spray) texturing as approved.

D. Upon approval of sample to act as texture standard, apply texturing compound by mechanical spray, in accordance with USG handbook instructions and recommendations and other applicable industry standards.

3.4 CLEAN UP and PATCHING

A. Prior to application of surface finishes, clean and repair all surface damage or imperfections caused by the work in this Section. Clean up adjacent surfaces which may be damaged by joint com-pound splatters, etc. Leave the surfaces ready to receive final surface finishes, as specified hereinafter.

END OF SECTION 09 21 16

SECTION 09 50 00 – ACOUSTICAL TREATMENT

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUBMITTALS

A. Within 30 days of Contract execution, submit per GENERAL CONDITIONS AND SECTION 01 33 00:

1. Manufacturer's published literature for specified products and accessories as applicable, including manufacturer's specifications, physical characteristics and performance data, as well as directions and instructions for application.

2. Samples: Submit 2 samples, minimum 12" x 12", of each type of unit specified herein.

1.2 QUALITY ASSURANCE

A. Installers shall be approved by manufacturer of material or system being installed for any material or system for which the manufacturer provides such an approval program.

B. For the fabrication and installation of the suspended acoustical ceiling system, use only personnel who are thoroughly trained and experienced in the fabrication and erection of the selected system. In acceptance or rejection of installed suspended acoustical ceiling, no allowance will be made for lack of skill on the part of installers.

1.3 CODES

A. Comply with all requirements of governing authorities and Washington State Survey and Rating Bureau, including:

1. IBC, latest Edition Section 803.9;

2. ASTM Standards C-635, C-636, E-580 and E-580M;

3. All applicable requirements of Acoustical Materials Associations Bulletin, "Architectural Acoustical Materials".

1.4 COORDINATION

A. Work hereunder requires coordination with trades whose work connects with, or is affected or concealed by, acoustical units, including electrical fixtures. Verify relationships to work of other trades and install this work to maintain preapproved relationships. Do not install filler panel acoustical units until all other trades have completed their work, insofar as possible, to minimize soiling of surfaces.

1.5 DELIVERY, HANDLING and STORAGE

A. Deliver all manufactured materials in original containers bearing manufacturers' name and brand. Use only one brand for each type of unit throughout job. Store materials within building in suitable locations.

B. Use all means necessary to protect acoustical material before, during, and after installation and to protect the installed work and materials of all other trades. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 – PRODUCT

2.1 MATERIALS

A. Suspension Grid Systems: Grid system shall be inverted "T" type, single plane grid; typically 1-1/8" web with 1" flange (1-1/2" webs at locations required to carry heavier loads) " x " grids as shown on the Drawings; Armstrong, USG Donn Products, Inc., National Rolling Mills, Inc., Chicago Metallic Corporation, or approved, conforming to ASTM C635.

1. The system shall be complete with all supporting members, splices, springs, anchors, wall cornices, and adapters for light fixtures and ceiling grilles, plus all accessories of every nature as detailed on the Drawings or required for complete installation such as self-adhesive sponge rubber weatherstripping at wall angle. Exposed flanges of perimeter moldings and suspension members shall be factory finished off-white.

B. Resilient Tape for use at wall angles on irregular surfaces, as detailed or called for shall be black butyl rubber, adhesive 1 side, as manufactured by 3M, or approved.

C. Acoustical Tile Types:

1. AT-1 - (Suspended) Armstrong #870 Clean Room VL or equal products by or other prior approved manufacturer, unperforated, lay-in panels for exposed grid suspended ceilings, nominally sized 24" x 48" x 5/8", but properly dimensional to fit the grid pattern shown on the Drawings. Flame Spread Index of 0-25, in accordance with Class A (Fed. Spec. SS-S-118B); 25 or under UL label. Color: White.

2. AT-2 - (Suspended) Armstrong #1729 or equal products by or other prior approved manufacturer, fine fissured, medium texture, lay-in panels for exposed grid suspended ceilings, nominally sized 24" x 48" x 5/8", but properly dimensional to fit the grid pattern shown on the Drawings. Noise Reduction Coefficient (NRC) .55, Flame Spread Index of 0-25, in accordance with Class A (Fed. Spec. SS-S-118B); 25 or under UL label. Color: White.

3. AT-3 – (Glue-up) Armstrong #746 or equal products by other prior approved manufacturer, 12" x 12" x 5/8" fissured square (beveled) edge. Noise Reduction Coefficient of .55, Flame Spread Index of 0-25 in accordance with Class A (Fed. Spec. SS-S-118B); 25 or under UL label. Color: White.

D. Acoustical Batts at Walls: As scheduled and noted on Drawings, fiberglass acoustical batts, Manville, Certainteed, Owens-Corning, or approved. Thickness to match framing depth, unless otherwise noted. Width of batts as appropriate for spacing and type of framing.

E. Acoustical Batts at Ceilings: Same as above, 6" thick.

F. Tile Adhesive: Tile Manufacturer's own or recommended, proper for specific application conditions.

G. Other Materials: All other materials, not specifically described, but required for a complete and proper installation of acoustical treatments called for shall be as provided by the Contractor subject to the approval of the Architect.

PART 3 – EXECUTION

3.1 EXTRA STOCK

A. Generally, order and deliver a minimum of an additional 3% of each type of acoustical unit specified, for maintenance use, at no additional cost to Owner.

3.2 INSPECTION

A. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. Verify that materials can be installed in accordance with the original design, all codes and regulations, and the returned shop drawings.

3.3 INSTALLATION

A. Installation of Suspended Grid: Support suspension system by 12-gauge hanger wires. Hangers, and entire grid system, shall be securely attached to structural system, conforming to referenced ASTM standards.

1. Erect metal "T" members in the pattern shown on the Drawings, spacing members symmetrically about the centerline of areas in both directions, unless otherwise shown on Drawings or approved shop drawings.

2. Space hanger wire a maximum of 4 feet on centers along main runners.

3. Accurately level all main runners; space main runners a maximum of 4 feet on centers.

4. Space cross "T" members and secure to main runners and wall angles in accordance with the approved shop drawings.

5. Securely anchor all wall angle members in place; install 1/2" self--adhesive, sponge rubber weatherstripping between wall angle and wall surface to fill voids of irregular wall surfaces as may be required. Provide and install hold-down clips for all ceiling

boards at fire-rated ceilings. 5% of hold-down clips shall be accessible type clips installed, and also furnish an additional 5" of accessible clips for Owner's future use.

6. Make all grids level within a tolerance of 1 in 500 and straight within a tolerance of 1 in 100.

7. Furnish and install lateral bracing consisting of at least 12-gauge wire, splayed at 45 degrees, in the following locations and as required under "CODES AND AUTHORITIES" hereinbefore:

   a. At the midpoint of all unsupported partitions exceeding 12 lineal feet.

   b. At 12 feet on center each way in all large ceiling areas not restrained by partitions.

8. Secure all lateral bracing to structural members; secure at right angles to the direction of the partition and four way in large ceiling areas.

B. Installation of Acoustical Tile Panels: Install all acoustical lay-in panels in the exposed "T" grid system so that linearity of facing is in one direction only, if directional. Trim neatly and handle carefully. At tegular ceilings, boarder pieces shall be tegular cut.

C. Acoustical Tile (12" x 12"): Lay out work centered symmetrically about centerlines of ceiling areas in both direction and spaced so that no cut tile is less than 1/2 tile width, unless specifically shown or approved otherwise.

1. Alternate direction of linearity in pattern (if any) to achieve a "parquet" appearance. Cut and fit neatly at perimeter edges, beveling back slightly to provide a uniform reveal joint approximately 1/16" wide at walls. Apply with adhesive in strict accordance with manufacturer's printed instructions and recommendations.

D. Acoustical batts shall be cut, fit, and installed carefully and neatly. Fit tightly to framing, around light fixtures, pipes, wires, etc.

E. Install other materials as hereinbefore specified, as detailed and as recommended by manufacturer.

3.4 CLEAN UP

A. Completely remove all finger prints and traces of soil from the surfaces of grid and acoustical ceiling boards, using only those cleaning materials specifically recommended for the purpose by the manufacturers of the materials cleaned.

END OF SECTION 09 50 00

SECTION 09 65 00 – RESILIENT FLOORING and BASE

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUBMITTALS

A. Within 45 days of Contract execution, and in accordance with requirements of Section 01 33 00, submit actual samples of manufacturers' complete current line(s) of patterns and colors.

B. When requested, submit 2 samples of each material specified herein in the selected color(s).

1.2 DELIVERY and STORAGE

A. Deliver materials to job site in manufacturers' original, unopened packaging and adequately protect against damage while stored in dry location at the site.

PART 2 – PRODUCT

2.1 MATERIALS

A. Resilient Flooring:

1. Sheet Vinyl Type-1: Mohawk "Healthy Environments HET Collection" (Calmness II, Ephemeral II, Juniperus II, Sisalana II, or Therapeutic II), commercial grade heterogenous resilient sheet, .080" overall thickness, 20 mil wear layer, M-Force finish, and solid color heat weld rod to match the flooring. Color as selected from manufacturer's standard color line.

2. Sheet Vinyl Type-2: Mohawk "Healthy Environments Medella Hues Fleck Collection" (Medella Fleck or Medella Hues), commercial grade homogenous resilient sheet, .080" overall thickness, M-Force finish, and solid or patterned color heat weld rod to match the flooring. Color as selected from manufacturer's standard color line.

3. Sheet Vinyl Type-3: Nora by Interface "Norament" one-piece homogenous rubber stair tread (Arago, Grano, Hammered, Round, or Satura). Color as selected from manufacturer's standard color line.

B. Adhesives: As recommended specifically by manufacturer of material to be installed.

C. Base: All base in this portion of the work shall be first commercial quality, rubber or vinyl, in continuous lengths, as manufactured by Roppe, Johnsonite, Flexco, Burke, or approved.

1. Base shall be **cove** at hard surfaced areas and carpeted areas, 6" high at restrooms and 4" high typical elsewhere unless noted otherwise, .080" gauge, wrapped outside corners and mitered inside corners.

D. Stair Stringers (Rubber Skirting): Shall be of same manufacturer as base, 0.080 gauge, 10" height, color as selected.

E. Transition Strips and Edges: Vinyl transitional moldings, wedges, etc., as noted on Drawings or required, at all transitions to resilient flooring, carpet, etc. Johnsonite, Roppe, Burke, Mercer, or approved. Sizes and colors as shown, required and approved.

F. Other Materials: All other materials not specifically described, but required for a complete and proper installation of resilient flooring and vinyl base shall be only as recommended by the manufacturer of the material to which it is applied and shall be subject to the approval of the Architect.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine all surfaces to receive work and verify that they are in proper condition to receive work of this Section. Do not proceed until improper surfaces and conditions have been corrected. Starting work included under this Section indicates acceptance of surfaces by the installer.

3.2 INSTALLATION

A. Preparation: Subsurfaces shall be thoroughly dry (verify by moisture meter tests), free of unevenness, foreign material (oil, grease, paint, etc.) and broom clean. Maintain temperature recommended by manufacturer in spaces where work is being done and where materials are stored for period of time. Contractor is cautioned that use of curing compounds for concrete slabs will not be allowed in areas scheduled under this Section.

B. Use approved latex floor filler as required at uneven floor areas to create an even surface for resilient flooring installation. Flooring shall be removed and subfloor leveled by filling or grinding if unevenness telegraphs through, resilient flooring during guarantee period.

C. Comply with manufacturers' written instructions and use applicator approved by manufacturer. Apply prime per recommendations of manufacturer.

D. Seat all flooring firmly into adhesives; make joints tight, straight and inconspicuous. Any door opening between spaces having different types of flooring at which no threshold occurs, shall have change of material made under door in closed position, as detailed on Drawings.

E. Make finish work free of buckles, cracks, breaks, waves and projecting edges, neatly fitted to projections. Apply edging strips at exposed edges of material not otherwise protected so top of strip is at same level as flooring.

F. Base shall be installed with inside corners mitered.

3.3 CLEANING and FINISHING

A. Cleaning, Protection and Finishing: After installation, sweep floors of particles and other foreign material harmful to flooring and immediately remove all surplus adhesive from adjacent surfaces.

B. Thoroughly clean all residual or excess adhesive from floors, base and adjacent surfaces, using only solvents, or cleaning agents, and methods, specifically approved by flooring and/or base manufacturers.

C. After adhesive has set properly, damp mop and apply light coat of floor polish (if recommended by flooring manufacturer).

D. Neatly apply non-staining building paper, firmly fastened down, to floor surfaces.

E. Near completion of the project and when directed by Architect, remove paper, clean and buff flooring per manufacturers' printed instruction. Use no acids or caustic solutions.

END OF SECTION 09 65 00

SECTION 09 67 23 – RESINOUS FLOORING

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Urethane Concrete Flooring – troweled urethane cement composition flooring with slip resistant broadcast.

B. Stripping of any existing sealers, fluid applied coatings and any other features that would obstruct proper application and adhesion of the flooring system shall be removed as a part of the floor installation and the floor properly prepared.

1.2 SUBMITTALS

A. Per requirements of Section 01 33 00, submit:

1. Complete list of all materials and equipment proposed to be furnished and installed under this portion of the work, giving manufacturers' name, catalog cuts and catalog number for each item where applicable. Accompanying the materials list, furnish copies of the manufacturers' current recommended method of installation for the special coating and sealer materials.

2. Certification from the Contractor/Applicator that:

a. Surfaces to receive special coating and sealer materials are clean and at a moisture content appropriate for the floor system installation.

b. Materials were applied in strict accordance with the manufacturers' current recommendations.

1.3 GUARANTEE

A. Contractor shall furnish a written warranty covering both material and workmanship for a period of (2) years from date of installation.

B. Manufacturer's Warranty: Manufacturer's standard limited warranty for the specified term.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with ISO certification and a minimum ten years documented experience.

B. Installer Qualifications: Specializes in installations to that required for Project with five years' experience. Engage an SSPC Concrete Coatings Inspector certified to perform inspections on Project. Installer will be acceptable to materials manufacturer.

C. Source Limitations: Each product type from single manufacturer ensuring uniformity.

D. Prior to commencing the installation, the Contractor shall install, with Owner's approval, a mutually agreed upon sample (mock-up) to show final color and texture of the system. This mock-up shall serve as a job standard for the final installation.

1.5 PRE-INSTALLATION CONFERENCE

A. Pre-installation Meetings: Coordinate work of this Section, with related work.

1. Attendance: Subcontractor performing work and manufacturers and fabricators involved, or affected by, installation. Coordinate installations that precede or follow.

2. Agenda: Review progress of construction activities and preparations for the particular activity under consideration. Agenda shall include schedule, drain and floor sink interface, detailing, door thresholds, responsibilities, critical path items, and approvals.

3. Record, agreements, and disagreements, and corrective measures and actions.

4. Reporting: Distribute minutes to each party present and others requiring information.

1.6 DELIVERY, HANDLING and STORAGE

A. Deliver materials in original sealed containers, clearly marked with manufacturers' name, brand name, type of material, and color.

B. Use all means necessary to protect materials from freezing or intrusion or foreign matter, before, during and after application and to protect the installed work and materials of all other trades.

C. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

D. Store materials where they are protected from damage and direct sunlight and in an enclosed, conditioned, area where temperatures are not less than 50 degrees F. or over 80 degrees F.

1.7 PROJECT CONDITIONS

A. Evaluate the substrate condition, including moisture content and extent of substrate leveling and repairs required, if any.

1. Remove any sealers, coatings, or other features that would impede proper adhesion of the flooring system to the substrate.

2. Patch floor and provide proper filler to create a level uniform floor.

B. Coordinate flooring work with other trades to ensure adequate illumination, ventilation, and dust free environment during application and curing of the flooring.

C. Protect all adjacent surfaces from damage or staining which may be inadvertently caused by the work.

D. Comply with material manufacturer's recommended temperature limitations for flooring application.

PART 2 – PRODUCT

2.1 MANUFACTURER

A. Acceptable Manufacturer:

1. Crossfield Products Corporation, which is located at: 3000 E. Harcourt Street; Rancho Dominguez, CA 90221, Phone: 925-513-1500, Email: chrism@dexotex.com; Web: www.dexotex.com.

B. Equivalent products by other manufacturers shall allowed subject to prior approval as outlined in Section 01 25 00.

2.2 MATERIALS

A. Troweled Urethane Cement Composition Flooring with Slip Resistant Broadcast:

1. Basis of Design: Dex-O-Tex Tek-Crete SL-B by Crossfield Products.

2. Physical Properties:

a. Compressive Strength (ASTM C579): 6,100 psi (42.0 MPa).

b. Thermal Distortion (350 degrees F Emersion): Passes.

c. Tensile Strength (ASTM C307): 1,000 psi (6.89 MPa).

d. Flexural Strength (ASTM C580): 2,000 psi (13.8 MPa).

e. Thermal Co-Efficient of Thermal Expansion (ASTM C531): 1.5 x 10E5.

f. Density (ASTM C905): 130 pcf (20.4 kN/cu.m).

g. Water Absorption (MIL-PRF-3134): 0.64 percent.

h. Surface Hardness (ASTM D2240) 85-90 Durometer "D".

i. Abrasion Resistance (ASTM D1044): 33mg.

j. Adhesion (ASTM D4541): 400 psi (2.76 MPa), 100 percent failure in concrete.

k. Flammability-Critical Radiant Flux (ASTM E648): 1.07 watts/sq.cm.

l. Resistance to Fungal Growth (ASTM G21): Passes, Rating 1.

3. Body Coat: 3/16 inch (6 mm) thick with slip resistant aggregate to achieve ¼ inch

4. Color as selected by Architect.

5. Top Coat: QuikGlaze.

B. Grout Coat:

1. Basis of Design: Dex-O-Tex Positred O by Crossfield Products.
2. Apply 1 coats at 16-20 mils.
3. Withstands heavy and abusive service.
4. Excellent chemical resistance.

C. Polyaspartic Sealer:

1. Basis of Design: Dex-O-Tex QuikGlaze by Crossfield Products.
2. Apply 1 coats at 8 mils with Slow Track
3. Withstands heavy and abusive service.
4. Excellent chemical resistance.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Do not begin preparation and installation until substrates are properly constructed and inspected complying with ACI 311.4R-05 Guide for Concrete Inspection. The General Contractor is to correct non-conformities if defects are discovered. Repair per ACI 546.R-04. Turn over work in broom clean condition free of debris and foreign matter.

B. If substrate preparation is responsibility of another contractor, inspect per ACI 311.4R-05 Guide for Concrete Inspection by a certified SSPC CCI inspector. If preparation is not satisfactory or if surface is contaminated, notify Architect in writing. Do not proceed with the installation before the deficiencies have been satisfactorily corrected.

C. Perform moisture testing per ASTM F1869 and F2170. Document results per this specification. If MVER or RH exceeds manufactures recommend level for specified product. Apply vapor control primer before proceeding.

D. Verify the substrate has proper slope for drainage. If proper slope for drainage is not in the substrate notify the Architect and General Contractor immediately. Do not proceed with flooring installation until the conditions are corrected.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to commencement of the preparation and installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under project conditions.

C. Concrete Surfaces: Shot-blast, or diamond grind per SSPC SP-13/NACE 6. Remove material to provide a sound surface free of laitance, glaze, efflorescence, bond inhibiting curing compounds or form release agents. Remove grease, oil, and other penetrating contaminates. Repair damaged and deteriorated concrete to acceptable condition per

ACI 546.R-04. Produce a surface profile equal to ICRI 310.25 CPS 2, CPS 3, or CPS 4. Leave surface free of dust, dirt, laitance, and efflorescence.

D. Cut 1/8" X 1/2" keyways around the perimeter, around drains, clean outs, access panels or other flooring interruption, and at expansion or isolation joints.

E. Verify proper surface profile per ICRI 310.25 CSP coupons. Perform water break test and tape dust cleanliness test per ISO 8502-3 to determine surface is acceptable to proceed.

3.3 INSTALLATION

A. Apply Flooring System components according to manufacturer's written instructions. Produce a uniform, monolithic wearing surface of thickness, color and texture indicated.

1. Coordinate application of components. Provide optimum adhesion of coatings to substrate, and optimum intercoat adhesion.

2. Cure coatings per manufacturer's written instructions. Prevent contamination during application and curing processes.

3. Expansion, Isolation and Control Joint Treatment: At substrate expansion, isolation and control joints, comply with resinous flooring manufacturer's written instructions.

4. Contractor shall keep daily logs recording the work performed and environmental conditions as required by the materials manufacturer.

B. Install 4" integral cove base with 5/8" radius at all vertical horizontal transitions.

C. Self-Leveling Body Coats: Apply in thickness indicated for flooring system.

1. Aggregates: Broadcast aggregates at rate recommended by manufacturer. After resin cures, remove excess aggregates. Provide surface texture indicated.

D. Top Coat: Tek-Crete Sealer CP. Apply in number indicated for flooring system and at spreading rates recommended by manufacturer to produce wearing surface indicated.

3.4 CLEANING AND PROTECTION

A. Clean products after 96 hours cure in accordance with the manufacturer's recommendations.

B. Prohibit foot and wheel traffic over flooring for 24 hours. Light foot traffic is acceptable after 24 hours. Normal traffic after 48 hours.

C. Do not expose to harsh chemicals until full 7 days cure.

D. Touch-up, repair or replace damaged products before Substantial Completion

E. Provide floor protection acceptable to the materials manufacturer.

F. Remove waste materials, rubbish and debris and dispose of them in accordance with local regulations.

END OF SECTION 09 97 23

SECTION 09 68 00 - CARPETING

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Supply and install all carpeting work, including floor preparation and miscellaneous work required as shown on Drawings and as specified herein.

1.2 SUBMITTALS

A. Within 30 days of Contract execution, and in accordance with requirements of Section 01 33 00, submit:

1. Samples: Two 16" x 24" (min.) samples of each carpet material to be used. Each carpet sample shall bear manufacturers' label and exact material identification.

2. Layout drawings per DIVISION 1 requirements, showing location of all seams proposed to be made in the carpeting. Layout shall provide for minimum possible cross seaming. Carpeting shall be laid with the grain and nap of the carpet in one direction.

3. Certification: Submit certification of flammability and smoke contribution tests which meet requirements of authority having jurisdiction and as may be specified under MATERIALS below. Fire tests shall be made by a testing laboratory approved by Washington State Fire Marshall and name of testing laboratory shall be included with test certificate. Provide certificate that carpet delivered to Project conforms to these Specifications.

4. Also Submit Guarantees and Instructions to Owner, as specified below as a part of O & M Manuals prior to pre-final inspection.

B. Instructions to Owner

1. As a condition of final acceptance of this work, furnish Owner, as a part of the O & M Manuals specified in Section 01 78 23, complete carpet care and maintenance instructions. Include exact identification of carpet and complete list of recommended cleaners for the full range of soil and stain sources.

1.3 PRIOR APPROVALS/SUBSITUTIONS

A. All carpet goods other than the exact line and manufacturer specified, if any, must be approved prior to bidding, in accordance with procedures specified in Section 01 25 00. Requests for approval must be accompanied by at least two sample folders consisting of at least one construction sample at least 5" x 7" in size, actual goods samples of all colors (and patterns) available, complete specifications of carpet construction, and manufacturers' guarantee. Photographic representations of colors not acceptable.

B. Colors available for selection shall be valid criteria for approval or non-approval, and the Architect's decision shall be final.

C. Substitutions after Contract execution will be approved only in cases of bone fide dire emergencies (i.e., strikes, fire, etc., at the manufacturing level).

1.4 GUARANTEES

A. Carpet installation shall be guaranteed as called for by the GENERAL CONDITIONS. Items furnished and installed under this Section of the Contract will be inspected by the Architect following installation. Any item not in strict accordance with the Drawings and Specifications, or with the best practices of the trade shall be promptly replaced by the Contractor at the convenience of the Owner and at no cost to the Owner. Correct defects in materials and/or workmanship, when requested, during the 1-year guarantee period. Repair or replace carpet as Architect judges necessary at no additional cost to the Owner.

B. Carpet Type-1: Carpet tile shall have Limited Commercial Lifetime Warranty and shall be guaranteed by manufacturer against excessive wear (edge unraveling, de-lamination of back, tuft-bind failure) as follows:

1. Wear: Carpet tiles will not wear more than 10% of their surface pile weight from abrasive wear. "Abrasive wear" means fiber loss from the carpet tiles through normal abrasion, not crushing or flattening of the carpet pile in any area, nor staining, soiling, fading, or change in carpet appearance, nor fiber loss due to abnormal usage of the carpet tiles.

2. Lifetime Static: Carpet tiles will not give static discharges in excess of 3.5KV when tested under AATCC Test Method 134 (Step).

1. Edge Ravel/Zippering: Carpet tiles will not edge ravel or zipper.

2. Delamination: Carpet tiles will not delaminate.

3. Dimensional Stability: Carpet tiles will not lose their dimensional stability per the AACHEN test ISO 2551.

4. Colorfastness to Light: Carpets will resist change color due to sunlight exposure to exceed the equivalent of 4.0 on the gray scale for color change as measured in accordance with AATCC Method 16E.

5. Ten (10) Year Warranty: Colorfastness to Atmospheric Contaminants Carpets will resist change color due to atmospheric contaminants (Ozone and Nitrous Oxides) as measured by AATCC 164 and AATCC 129. Tested carpet will not rate less than a 3.0 rating on the grey scale for color change.

6. Ten (10) Year Limited Stain Warranty: The designated carpet, when installed and maintained as recommended by Mohawk Group, will resist permanent stains caused by spills of all conventional acid based substances, subject to the Limitations set forth in the Ten Year Stain Warranty.

B. Entrance Mat Type-1: Manufacturer's standard warranty.

1.2 QUALITY ASSURANCE

A. For cutting, laying and trimming of carpeting, use only thoroughly trained and experienced carpet installers who are completely familiar with the materials specified, the Manufacturer's recommended methods of installation and the requirements of the work. (Carpet subcontractor shall be approved in writing by the carpet manufacturer and Architect.)

1.3 AREA and MEASUREMENT

A. Contractor shall have calculated (measured) the area(s) to be carpeted prior to bidding and the yardage amounts shall be the responsibility of the Contractor.

B. Where spaces are scheduled to be carpeted, carpet floors of alcoves and closets opening off these spaces, unless otherwise noted.

1.4 DELIVERY, HANDLING and STORAGE

A. Deliver materials to job site in protective wrapping and adequately protect against damage while stored in dry location at the site. Use all means necessary to protect carpeting materials before, during, and after installation and to protect work of other trades. In the event of damage to carpeting and/or building, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 – PRODUCT

2.1 MATERIALS

A. Carpeting: Each type of carpeting, as specified below shall be uniform and true to line as produced by a single manufacturer, and shall be the exact goods specified or prior approved equal and be specifically approved by the Architect in writing prior to bidding.

B. Carpet Type-1 (carpet tiles):

1. Mohawk Group, Pure Genius II Collection, 24" x 24".
    a. Surface Texture – textured multi colored loop
    b. Gauge – 1/10
    c. Tufted Pile Weight – 18.0 oz. per square yard
    d. Total Thickness - .201"
    e. Stitches Per Inch – 12
    f. Dye Method – solution dyed/yarn dyed
    g. Fiber Type – Colorstrand nylon
    h. Stain/Soil Release Technology – EcoSentry Plus stain and soil protection

i. Density – 4,286

j. Backing Material – EcoFlex Matrix

k. Color – to be selected

l. Installation Method – to be selected

A. Entrance Matting – 1:

1. Mats, Inc. Super Nop 52 Tiles, tile size 20" x 20" (nominal), 52 oz heavy weight pile of 100% Asota solution dyed UV stabilized polypropylene fibers with large nop design, needle punched construction with Eco-Bitumen backing. Color to be selected.

B. Edging/Transition Strips: Solid vinyl wedges, tees, etc., set in adhesive, at transitions to concrete or resilient floorings, carpet to carpet and carpet to mat transitions. Flexco, Roberts, or approved. Sizes as shown, or required and approved. Colors as selected.

C. Tack Strips & Miscellaneous Materials: As required for a complete installation per manufacturer's installation instructions.

D. Adhesives: 'Quick Release' type, as manufactured or recommended by the carpet goods manufacturer, and in the below-referenced installation manual.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Before proceeding with carpet installation, inspect thoroughly to be sure that floor surfaces are in proper condition to receive carpet.

B. Preparation: Under this Section carpet installer shall remove all existing residue from previous flooring installations to the extent the new floor can be installed without imperfections telegraphing through the flooring or where existing conditions will create problems with proper adhesion.

1. Subsurfaces shall be thoroughly dry (verify by moisture meter tests), free of unevenness, foreign material (oil, grease, paint, etc.) and broom clean. Maintain temperature recommended by manufacturer in spaces where work is being done and where materials are stored for period of time. Contractor is cautioned that use of curing compounds for concrete slabs will not be allowed in areas scheduled under this Section.

2. Use approved latex floor filler as required at uneven existing floor areas, and where new patching or trenching has occurred, to create an even surface for carpet installation. Flooring shall be removed and subfloor leveled by filling, bead blasting, or grinding if unevenness telegraphs through, resilient flooring during guarantee period.

C. Carpet Installation: Installation shall be direct glue-down type.

1. Install carpet using applicable methods as approved and outlined in the "Standard for Installation Specification of Commercial Carpet" CRI 104, Current Edition, published by the Carpet and Rug Institute, 706-278-3176, www.carpet-rug.org.

2. Cut and fit closely and evenly at walls and to transition/edge strips and thresholds. Seams and cross seam selvage edges trimmed true and uniformly with carpet construction. All seams shall be tightly fit without visible cut fiber ends or uneven rows. Match carpet lines and patterns at seams, in all directions.

3. Install with borders or areas of differing colors or types as indicated on Drawings.

4. Stretch carpet to proper extent under conditions of temperature and humidity at time of installation, and for type of carpet construction, to avoid future loosening, ripples or puckers.

3.2 CLEANING and PROTECTION

A. Cleaning and Protection: Remove spots, smears, stains, etc., with materials recommended by carpet manufacturer. Remove loose threads with sharp scissors and vacuum clean. Leave surfaces clean and free from ripples, scallops and puckers

B. Remnants: Upon completion, bundle all usable remnants and deliver to Owner for possible future repairs.

END OF SECTION 09 68 00

SECTION 09 77 20 – FIBERGLASS REINFORCED PANELS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 STANDARDS

A. American Society for Testing and Materials: Standard Specifications (ASTM)

1. ASTM D 256 - Izod Impact Strengths (ft #/in)
2. ASTM D 570 - Water Absorption (%)
3. ASTM D 638 - Tensile Strengths (psi) & Tensile Modulus (psi)
4. ASTM D 790 - Flexural Strengths (psi) & Flexural Modulus (psi)
5. ASTM D 2583- Barcol Hardness
6. ASTM D 5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
7. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.2 SUBMITTALS

A. Within 30 days of Contract date, and in accordance with provisions of Section 01 33 00, submit:

1. Complete Manufacturers' Information on all items intended for installation under work of this Section.
2. Guarantees, Operating and Maintenance Instructions and parts replacement ordering information as part of O & M Manuals.
3. Shop Drawings: Submit brochures and/or shop drawings of all items showing sizes of members, methods of construction and mounting techniques.
4. Samples: Where specifically stated herein under the particular item of work, submit a minimum of 2 samples.

1.3 GUARANTEE

A. Submit to Owner manufacturer's standard warranty document executed by an authorized company official.. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.

1.4 QUALITY ASSURANCE

A. Conform to ASTM D792 Standard Test Method for Density and Specific Gravity (Relative Density) of plastics by displacement and ASTM E84 Standard Test Method for Surface Burnign Characteristics of Building Materials.

B. Manufacture product in a ISO 9001 and ISO 914001 certified facility, capable of providing field service representation during fabrication and approving application method.

C. Obtain products from a single manufacturer.

D. Fabricator/Installer shall be approved by the manufacturer and be experienced in performing work of similar type and scope.

1.5 DELIVERY, HANDLING and STORAGE

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer.

1.6 COORDINATION

A. Coordinate with all trades whose work relates in any way to items specified herein. Ensure that all blocking, backing, access, etc., is provided as work progresses.

1.7 MEASUREMENTS

A. Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

PART 2 – PRODUCT

2.1 MANUFACTURER

A. Product selection is based on Marlite, 1 Marlite Drive, Dover, OH 44622, (800) 377-1221, or prior approved equal products. Equivalent products of Kemlite, NUDO, or prior approved manufacturer are permitted.

2.2 MATERIALS

A. FIBERGLASS REINFORCED PANELS

1. FRP: Standard FRP, Pebbled Surface ("P" series), 4' x 8' x 3/32" panels. Color to be selected from manufacturer's standard line of colors.

B. Trim and Accessories: Provide coordinated seam, edge, and corner treatment trims. Provided PVC trim and color matched acrylic latex caulk with silicone for all plastic laminate faced panels.

PART 3 – EXECUTION

3.1 FABRICATION

A. Fabricate wall panels and accessory items in accordance with manufacturer's recommendations and approved submittals. Fabricate panels to profile indicated on drawings.

3.2 INSTALLATION

A. Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

B. Install wall panels plumb and level and accurately spaced in accordance with manufacturer's recommendations and approved submittals. Fasten wall panels to supporting substrate with adhesive (or fasteners) approved for use by the manufacturer and suitable for the adjoining construction.

C. Install corner profiles, gaskets, trim, etc. with fasteners and adhesive appropriate for use with the adjoining construction as recommended by the manufacturer. Caulk all seams, spaced per manufacturer's requirements with color matched caulk.

3.3 CLEAN UP and PROTECTION

A. Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project site and legally dispose of debris.

B. Protect installed product and finish surfaces form damage during construction.

END OF SECTION 09 77 20

SECTION 09 91 00 – PAINTING

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide all painting and finishing work as specified herein and as noted on the Drawings. ALL surfaces, including existing items, surfaces and galvanized metals, shall be painted or finished as part of this work, unless specifically noted as not to receive a finish.

B. Certain items may be specified to be shop primed (or finished) in other Sections. Any required priming not so specified elsewhere in this specification shall be provided as a part of the work of this Section.

C. Surfaces Not to be Painted or Finished:
1. Drywall or plaster permanently concealed from view.
2. Wood (or plastic) structural/framing elements permanently concealed from view.
3. Concrete slabs.
4. Brick and stone masonry.
5. Factory finished paneling, equipment and other devices with an approved factory applied finish, unless specifically noted otherwise in the Specification Finish Schedule or on the Drawings.
6. Finish hardware, except where primed for a paint finish.
7. Plumbing fixtures; toilet room accessories, except as noted otherwise.
8. Lighting fixtures and electrical devices except as noted otherwise.
9. Concealed rough hardware.
10. Acoustical surfaces, unless specifically noted otherwise.
11. Glass, plastic, ceramic tiles, resilient flooring, topset resilient bases.
12. Exposed Category 5, 6 or better data cabeling, unless previously painted.
13. Areas noted as "unfinished" or "existing to remain" on Finish Schedules, or "existing finish to remain" on Drawings.

D. All surfaces and items not excluded above shall receive the various paint finishes, as scheduled.

1.2 FURNISHED, BUT NOT INSTALLED

A. For the Owner's maintenance purposes for touch up, furnish one properly labeled and sealed quart can of each type of finish coat of each color taken from the batch mix furnished for the work. Deliver to the Owner's representative before final payment and obtain a signed receipt therefore.

1.3 STANDARD SPECIFICATIONS

A. Except as otherwise specified, all work of this Section shall conform strictly to the standards for material and workmanship, set forth in the "Architectural Painting Specification Manual" published by the Master Painters Institute, 2800 Ingleton Avenue, Burnaby, B.C. Canada V5C 6G7, 1-888-674-8937, www.mpi.net.

1.4 DEFINITIONS

A. The term "MPI" refers to Master Painters Institute, and "APSM" refers to Architectural Painting Specification Manual. Refer to various sections for general definitions and to the APSM glossary for technical terms and industry colloquialisms.

1.5 INSPECTIONS AND TESTS

A. Comply with all requirements of APSM, Chapter 6 - Quality Assurance Programs.

B. The APSM Inspection and Warranty Program is not a required part of the Work.

C. Prior to starting any portion of this work, the Contractor shall also examine respective surfaces and verify that they are in proper condition to commence work of this Section. Do not proceed until improper conditions have been corrected.

1.6 APPROVED MANUFACTURERS

A. ONLY the approved paint products of the paint manufacturers listed in APSM, Chapter 5, under "Product List" may be used unless a specific manufacturer is listed in Finishing Schedule. When substitutes are proposed, use only those substitutes that are approved by MPI and the Architect in writing per conditions outlined in Section 01 25 00.

B. The Architect will furnish the Contractor a Paint and Finishing Color Schedule of colors selected either from manufacturers' stock colors as submitted by Contractor or specially requested color mixes. For bidding purposes and unless otherwise specified, refer to the Finish Schedules and paint or finish the following to match adjacent surfaces:

1. Access doors, registers, primer coated butts, primer coated door closers, exposed piping in finished spaces, electric conduit and panels exposed in finished spaces, exposed uncovered ductwork.

C. Allow in Contract for: 3 different color schemes for painting rooms; 10% approximately, of overall painting work (area) to consist of "deep colors", which require one additional coat above those specified.

1.7 SUBMITTALS

A. Unless otherwise specified hereinafter and before any painting or finishing work is started, submit samples of all finishes, selections, etc., to the Architect per Section 01 33 00.

B. Samples: Prepare 8x10 cards with color and finish selected. Furnish additional samples as required until colors, finishes and textures are approved. Retain approved samples to be used as the quality standards for final finishes.

1.8 WARRANTY

A. Provide Contractor's warranty of this work for a period of two (2) years from the Architect's documented date of Substantial Completion.

1.9 ENVIRONMENTAL CONDITIONS

A. Conform to all requirements of APSM unless otherwise specified hereinafter. Disregard of working in accordance with provisions set forth in these following paragraphs may cause warranty to be voided.

B. Weather Conditions: Do no exterior work on unprotected surfaces if it is raining or moisture from any other source is present, or expected before applied paints can dry or attain proper cure without damage thereto. Allow surfaces wetted by rain or other moisture source to dry and to attain temperatures and conditions specified hereinafter before proceeding with work, or continuation of previously started work.

C. Temperatures: Do no painting work when temperatures on the surface or of the air in the vicinity of the painting work are below plus 50 degrees F. or below those temperatures recommended by the manufacturer for the material type used. The minimum temperatures for latex finishes to be not less than plus 45 degrees F. for interior work and plus 50 degrees F. for exterior work, unless specifically approved in writing by the Architect and Paint Inspection Agency. See APSM.

D. Lighting: Minimum of 15 candle power per square foot on surfaces to be painted or finished.

E. Ventilation: Provide continuous ventilation as required for various materials used in the spaces scheduled, but not less than recommended by the paint and finish manufacturer for drying.

1. Follow moisture test per APSM.
    a. 12% for concrete and masonry
    b. 15% for wood
    c. 12% for plaster and gypsum board

1.10 PROTECTION

A. Adequately protect other surfaces from paint and damages caused by this work. Also adequately protect painted areas from damage by others such as painted door and relite frames, painted doors, painted or finished casework, etc.

B. Make good any damage caused by failure to provide suitable protection.

C. Removal of Flammable Rubbish: Place all materials which may constitute a fire hazard in closed metal containers and daily remove from site.

D. Removal of Hardware and Miscellaneous Items: Coordinate the work so that electrical outlets and switch plates, mechanical diffusers, escutcheons, registers, surface hardware, fittings and fastenings, are removed prior to starting work of this Section and reinstalled upon completion of the work.

PART 2 – PRODUCT

2.1 GENERAL

A. Provide paint, varnish, stain, enamel, lacquer, fillers, and related products for prime, intermediate and finish coats, of types, brand and manufacture listed in APSM, Chapter 5, latest edition, factory labeled for positive identification, in accordance with Finishing Schedule hereafter.

3.1 Materials not specifically noted in APSM such as linseed oil, shellac, thinners or other materials shall be quality not less than required by published Federal or State Specification Standards, and as manufactured by approved firms.

3.2 FINISHING SCHEDULE

A. **Exterior Surfaces:**

1. New Wood - Noted to be Painted: Exterior 6.4G, "Premium Grade"; alkyd primer and 2-coats latex exterior, MPI Gloss Level 5 (semi-gloss).

2. New Ferrous Metal (Not Galvanized): Exterior 5.1D, "Premium Grade"; alkyd metal primer and 2-coats alkyd, MPI Gloss Level 5 (semi-gloss).

3. New Non-Ferrous Metal (Including Galvanized Steel): Exterior 5.3A-Latex "Premium Grade"; cementitious primer and 2-coats exterior latex, MPI Gloss Level 5 (semi-gloss).

4. New Non-Ferrous Metal (Including Galvanized Steel): Exterior 5.3B Alkyd, “Premium Grade”; 3 coats, 1-coat cementitious primer, 2-coats approved exterior alkyd enamel, MPI Gloss Level 5 (semi-gloss).

5. New Galvanized Sheet Metal: Exterior 5.3H, "Premium Grade"; pretreatment primer, W.B. primer, 2-coats exterior latex, MPI Gloss Level 5 (semi-gloss).

6. Exterior Fiber Cement Soffits and Trim: Exterior 3.3A, “Premium Grade”; 3-coats latex, MPI Gloss Level 5 (semi-gloss).

7. **All exterior mechanical grilles and louvers shall be painted whether galvanized or not, unless finished in anodized aluminum as approved by Architect.**

8. Miscellaneous Surfaces: Any other surfaces not noted "not to receive finish" and/or not specifically scheduled above, shall be finished with an approved APSM system for that particular substrate. Choice of exact approved APSM system of finish shall be at Contractor's option.

B. **Interior Surfaces:**

1. New Gypsum Wallboard: Interior 9.2A; "Premium Grade"; 1-coat latex primer sealer and 2-coats interior latex, egg shell satin, MPI Gloss Level 3 (eggshell).

2. New Gypsum Wallboard (all restrooms, shower room, and Building 2’s Exam Room 108, and Storage 112): Interior 9.2F "Premium Grade"; 1-coat latex primer sealer and 2-coats water-based epoxy, MPI Gloss Level 4 (satin).

3. New Wood - Noted to be Painted: Interior 6.4R; "Premium Grade"; latex primer and 2-coats interior latex, semi-gloss, MPI Gloss Level 5 (semi-gloss).

4. New Exposed Ferrous Metal (Latex): Interior 5.1Q "Premium Grade"; rust inhibitive alkyd primer and 2-coats interior latex enamel, MPI Gloss Level 5 (semi-gloss).

5. New Exposed Non-Ferrous Metal (Including Galvanized): Interior 5.3A "Premium Grade"; pre-treatment primer, cementitious primer, 2-coats interior latex enamel, MPI Gloss Level 5 (semi-gloss).

6. Miscellaneous Surfaces: Any other surfaces not noted "not to receive finish" and/or not specifically scheduled above, shall be finished with an approved APSM system for that particular substrate. Choice of exact approved APSM system of finish shall be at Contractor's option.

PART 3 – EXECUTION

3.3 PREAPPLICATION PREPARATION

A. Conditions of Surfaces: Do not proceed until any discovered defects have been corrected and surfaces approved by Inspection Agency and specifying authority. Conform to APSM, Surface Preparations, as to surface conditions and preparations for each various surface to be painted or finished.

B. Starting work under this Section implies acceptance of the surface and substrate.

3.4 APPLICATION

A. Comply with requirements of APSM total program specifically, and as follows:

1. Special coatings, sealers, etc., shall be applied only by method(s) specifically recommended by manufacturer.

2. Each succeeding pigmented coat shall be distinguishably lighter than the previous coat. Tint all prime and undercoats to a color similar to, but darker than, finish coat.

3.5 COMPLETION AND CLEAN-UP

A. On completion of the work, carefully clean all glass, hardware, frames, etc, and remove all misplaced paint and finish spots, spills, splatters, etc., and leave the work neat and clean to the satisfaction of the Architect. Request final inspection from the Inspection Agency and/or MPI, if any.

END OF SECTION 09 91 00

SECTION 09 97 00 – SPECIAL COATINGS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Provide floor sealer at all interior concrete slabs not scheduled to receive carpet or other finish material.

1.2 SUBMITTALS

A. Per requirements of Section 01 33 00, submit:

1. Complete list of all materials and equipment proposed to be furnished and installed under this portion of the work, giving manufacturers' name, catalog cuts and catalog number for each item where applicable. Accompanying the materials list, furnish copies of the manufacturers' current recommended method of installation for the special coating and sealer materials.

2. Certification from the Contractor/Applicator that:

a. Materials conform to the requirements of the Specifications.

b. Surfaces to receive special coating and sealer materials are clean and at a moisture content considered to be a "dry state" which will not cause efflorescence on the coating by moisture evaporating.

c. Materials were applied in strict accordance with the manufacturers' current recommendations.

1.3 GUARANTEE

A. Manufacturers' standard written guarantee(s) of performance for the various coatings/applications.

1.4 QUALITY ASSURANCE

A. All materials applied by an experienced applicator must be approved by Architect and manufacturer of material or his distributor.

1.5 DELIVERY, HANDLING and STORAGE

A. Deliver materials in original sealed containers, clearly marked with manufacturers' name, brand name, and type of material.

B. Clearly mark percentage of silicon or acrylic resin on label of each container.

C. Use all means necessary to protect the liquid water repellent materials from freezing or intrusion or foreign matter, before, during and after application and to protect the installed work and materials of all other trades.

D. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

E. Store materials in areas where temperatures are not less than 50 degrees F. or over 85 degrees F., unless otherwise authorized by manufacturer.

1.6 JOB CONDITIONS

A. Do not proceed with application of materials when ambient temperature is less than 50 degrees F., or when low temperature of 40 degrees F. or less is predicted within a period of 24 hours after application.

B. Do not apply water repellent in rainy conditions or within 3 days after surfaces become wet from rainfall or other moisture.

C. Protect plants and vegetation which might be affected by fumes or alkalinity of the materials.

D. Protect bituminous or asphaltic coatings from overspray. Clean overspray from glass and metal using xylene or mineral spirits; follow with ammonia base window cleaner to remove haze left by solvent.

PART 2 – PRODUCT

2.1 GENERAL

A. All special coating and sealer materials shall be the product of one manufacturer and shall be either the one upon which the design is based, similar products of approved acceptable manufacturers or as approved in advance by the Architect.

2.2 MATERIALS

A. Sealer – Concrete Floors: Dayton Superior 1315 J22WB, water based acrylic copolymer transparent sealer containing 25% solids, or prior approved manufacturer.

B. Sealer – Typical at Exterior Concrete Slabs and Protrusions: Dayton Superior Weather Worker 40% J29 single component waterproofing protection water repellant, containing 40% silane, or prior approved manufacturer.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine all subsurfaces to receive work and verify that they are in proper condition to commence work of this Section. Do not proceed until improper conditions have been corrected.

B. Provide adequate ventilation. Allow no open flame in or near work area.

C. Verify that all special coating and sealer materials can be installed in accordance with all pertinent codes and regulations, the original design, and the referenced standards

3.2 PREPARATION

A. Verify that substrate has cured a minimum of 8 days prior to application of waterproofing, is free of soil, tars, oils, mortar smear, efflorescence and other contamination. Make certain that surface temperature is not less than 40 degrees F., that there is no surface moisture present, and that precipitation is not expected within 4 hours.

B. Remove, strip, curing compounds prior to installation, coordinate with requirements of Section 03 30 00.

C. Repair and fill all cracks and voids in mortar joints and elsewhere by pressing caulking firmly into crack. Color of caulking shall be selected to closely match color of mortar. Use urethane or polysulfide caulking. Obtain approval of conditions of surface by Architect and manufacturer or his distributor before start of application.

D. Remove dirt if necessary by scrubbing and allowing to dry thoroughly.

3.3 INSTALLATION

A. Use only equipment approved by material manufacturer and perform all work in accordance with manufacturers' printed instructions and recommendations.

B. Apply 2 coats of each sealer. Initial coat may be sprayed and backrolled. The final coat shall be roller applied only. Spray application not permitted for final coat.

C. Unless otherwise directed, clean and seal floors just prior to Substantial Completion.

END OF SECTION 09 97 00

SECTION 10 00 00 – MISCELLANEOUS SPECIALTIES

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUBMITTALS

A. Within 30 days of Contract date, and in accordance with provisions of Section 01 33 00, submit:

1. Complete Manufacturers' Information on all items intended for installation under work of this Section.

2. Guarantees, Operating and Maintenance Instructions and parts replacement ordering information as part of O & M Manuals.

3. Shop Drawings: Submit brochures and/or shop drawings of all items showing sizes of members, methods of construction and mounting techniques.

4. Samples: Where specifically stated herein under the particular item of work, submit a minimum of 2 samples.

1.2 GUARANTEE

A. Per GENERAL CONDITIONS. See various items for longer manufacturers' guarantees which shall govern.

1.3 DELIVERY, HANDLING and STORAGE

A. Deliver and store all items in dry, protected areas. Keep free of corrosion or other damage. Replace any damaged items or parts at no cost to Owner.

1.4 COORDINATION

A. Coordinate with all trades whose work relates in any way to items specified herein. Ensure that all blocking, backing, access, etc., is provided as work progresses.

1.5 MEASUREMENTS

A. Verify all dimensions shown on Drawings by taking field measurements; proper fit and attachment of all parts is required.

PART 2 – PRODUCT

2.1 MATERIALS

A. Access Panels: JL Industries, or approved equal, steel door and frame, hinged, white powder coated and finished painted per Section 09 91 00.

1. Type AP (ceiling access panels): JL Industries Model TM flush access panels, 14 gauge door, 16 gauge frame, sized 22" x 36" for attic access. See mechanical drawings for required sizes to access mechanical equipment in ceiling spaces.

2. Type AP (wall access panels): JL Industries Model TM flush access panels, 14 gauge door, 16 gauge frame, sized 14" x 14". See mechanical drawings for additional sizes as may be required.

B. Fire Extinguishers and Cabinets: Fire extinguishers and cabinets shall be provided in locations shown, ready for service by being charged just prior to date of Substantial Completion or early occupancy. Construction, installation and identification shall meet all codes, regulations and requirements of safety authorities. Mount top of fire extinguisher cabinets at 4'-6" above finish floor or as otherwise indicated on Drawings. All cabinets shall be sized to properly house the extinguisher provided.

1. Bracket mount extinguishers noted for installation without cabinets with top 4'-0" above floor, or as otherwise indicated on Drawings.

2. Fire extinguishers shall be J.L. Industries, Larsen Mfg. Co., Norris Industries, General, or approved. Cosmic 5E, 5 lb. dry chemical type, sized 14-5/8 x 6, enameled steel shell with pressure indicating gauge. UL rated 2A-10BC.

3. Cabinets shall be J.L. Industries', or approved equal, Academy #1025 G10 or #1027 G10 where recessing is possible (at new walls), as required for thickness of wall at each location, unless specifically noted for installation without cabinet. Finish as selected by Architect.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install all items per details on Drawings, manufacturers' printed installation instructions and any additional requirements specified. All wall mounted items shall be securely fastened to solid backing or blocking.

B. Provide all anchorage devices required to install the item and its appurtenances, complete. Furnish anchorage requirements in ample time when required to be built in by other trades.

END OF SECTION 10 00 00

SECTION 10 14 00 – IDENTIFYING DEVICES

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

1. All signage mounted in or on building(s).

1.2 SUBMITTALS

A. Within 45 days of Contract date, submit complete shop drawings to the Architect which show all sizes, graphic layout, finishes, details of manufacture and manufacturers' recommended installation techniques.

B. Accompanying the shop drawings, submit specified number of copies of a complete list of all materials proposed to be furnished and installed under this portion of the work, giving manufacturers' name, catalog number, and catalog cut for each item where applicable.

C. Submit 2 samples of each item, unless otherwise specified hereinafter.

D. All submittals to be made in strict accordance with requirements specified in DIVISION 1.

1.3 CODES, PERMITS and FEES

A. Signage shall comply fully with all applicable codes and regulations in effect at time of installation including Washington State Handicapped Accessibility Code and Federal ADA requirements. Where provisions of pertinent codes, regulations and standards conflict with these Specifications or Drawings, the more stringent provisions shall govern.

1.4 DELIVERY, STORAGE and HANDLING

A. Deliver and store materials in dry, protected areas. Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replace any damaged parts at no additional cost to the Owner.

1.5 COORDINATION

A. Coordinate with all other trades whose work relates to this work for placing of all required blocking, backing, etc., to ensure proper locations.

PART 2 – PRODUCT

2.1 MANUFACTURERS

A. Kroy Sign Systems, Vomar Products, Inc., Best Manufacturing Company, or approved equal.

2.2 MATERIALS

A. ADA Restroom Signs: Signs shall be 1/8" thick acrylic (phenolic) plastic unframed plaque. Raised white pictograms, text and Grade II Braille insure that ADA and ISA (International Symbol of Accessibility) requirements are achieved. All signs RC (rounded corners). Colors as selected.

B. Glue and Tape: Acrylic sheet may be glued or taped with commercial grade material compatible with acrylic sheet products and paints.

C. Other Materials: All other materials not specifically described, but required for a complete and proper installation of the work of this Section, shall be new, first quality of their respective kinds, and subject to prior approval of the Architect.

2.3 SIGN SCHEDULE

A.

Location	Mounting Location	Sign Content
1. Typical @ each ADA restroom	Interior wall	RESTROOM / with Woman/Man symbol and ISA
2. Typical @ non-ADA restroom	Interior wall	RESTROOM / with Woman/Man symbol

B. Provide "FIRE EXTINGUISHER" signs at all fire extinguisher locations.

C. Handicap Parking Signs and No Parking Signs: Safetysign.com (800) 274-6271 or equal products by other manufacturers.

1. WSDOT R7-801 Item T4565 - "RESERVED PARKING" "STATE DISABLED PARKING PERMIT REQUIRED"

2. MUTCD R7-8P/R7-8a Item T4592 - "VAN ACCESSIBLE"

3. No Parking Sign: W3610-A8D – "NO PARKING" and International No Parking Symbol. Sign to be located at the head of each access aisle adjacent to accessible parking space.

4. Handicap Parking Signs to be pole mount or building mount as indicated on the Drawings. Install pole signs as detailed on detail 27/A8.2. Sign post shall be 2" ID standard weight galvanized steel pipe with like galvanized steel cap, unless noted otherwise. Provide with appropriate connecting hardware and concrete foundation materials.

5. No Parking Signs Handicap Parking Sings to be pole mount or building mount as indicated on the Drawings. Install pole signs as detailed on detail 27/A8.2 (sim.).

Sign post shall be 2" ID standard weight galvanized steel pipe with like galvanized steel cap, unless noted otherwise. Provide with appropriate connecting hardware and concrete foundation materials.

PART 3 – EXECUTION

3.1 INSPECTION

A. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. Verify that all identifying devices may be installed in accordance with all pertinent codes and regulations, the original design, and the referenced manufacturer standards

3.2 INSTALLATION

A. Locations/Mounting Heights shall be as indicated on the drawings, or, if not so indicated, as directed and approved. In any case all signs required to conform to above cited handicapped access regulations shall be mounted at heights of between 48" and 60" above floor or grade, and at locations easily reachable (horizontally) from a finished floor or slab surface

B. Anchorage: Furnish and install all anchorage as required to secure all devices to the construction, as detailed on Drawings or as necessary to install complete. Provide anchorage in ample time when required to be built in by other trades

C. Install in strict conformance with the manufacturers' recommendations and as approved by the Architect.

3.3 CLEANING

A. Prior to Substantial Completion, clean all identifying devices of fingerprints or other marks in accordance with the manufacturers' directions

END OF SECTION 10 14 00

SECTION 10 28 00 – TOILET and BATH ACCESSORIES

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUBMITTALS

A. Within 30 days of Contract execution, and in accordance with requirements of Section 01 33 00, submit:

1. Complete manufacturers' information on all items intended for installation under work of this Section, including shop installation drawings and details, prior to ordering.

2. Operating and Maintenance instructions and parts replacement ordering information as a part of O & M Manuals

1.2 DELIVERY, HANDLING and STORAGE

A. Deliver and store all items specified herein in dry, protected areas. Keep free of corrosion or other damage. Replace any damaged items at no cost to Owner.

1.3 COORDINATION

A. Coordinate with all other trades whose work relates to items specified herein for placing of all required backing and furring to ensure proper locations.

B. Items required to be recessed, semi-recessed, etc., shall have templates provided to Contractor to ensure a proper rough opening is provided.

C. For OFCI and OFOI items, obtain templates and instructions from Owner in ample time to provide blocking, backing, openings, etc.

1.4 MEASUREMENTS

A. Verify all dimensions shown on Drawings by taking field measurements; proper fit and attachment of all parts is required.

PART 2 – PRODUCT

2.1 MATERIALS

A. Sanitary Napkin Receptacle (SNR): Bobrick #B-270 surfaced mounted, satin finished stainless steel.

B. Grab Bars: Bobrick #B-6806 1½" diameter stainless steel grab bars with snap flange, satin finished stainless steel with slip-resistant surface. Lengths as indicated on the Drawings.

1. Contractor's option to provide "L shaped" grab bar with stand-off mounting on long side meeting the requirements above in lieu of individual grab bars.

C. Mirrors: Bobrick B-290 glass mirror with stainless steel angle frame, sized 24" x 36", location per Drawings. Install on concealed wall hanger and secure with theft proof locking screws.

PART 3 – EXECUTION

3.1 INSTALLATION

3.2 Install items per respective manufacturers' published instructions and reviewed shop drawings.

3.3 Securely attach to proper blocking/backing or framing, using concealed fastening wherever possible. All exposed attachment hardware shall be vandal resistant type of stainless steel, or other approved rust-resistant finish.

3.4 Adhesive installations not permitted.

END OF SECTION 10 28 00

SECTION 12 24 00 – WINDOW SHADES

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Specified window treatment shall be installed at all exterior window openings for rooms scheduled for window treatment as determined by the Room Finish Schedule (suspended from the bottom of headers, or as detailed), manual control of raising and lowering by cord; provide with spring tension fully and shock absorber at shades.

1.2 SUBMITTALS

A. Within 30 days of Contract date, and in accordance with the provisions of Section 01 33 00, submit the following:

1. Schedule indicating opening sizes, tolerances required, installation of window treatment at window opening, method of attachment, clearances, and operation.

2. Product data indicating physical and dimensional characteristics and operating features.

3. Samples (2) 6" x 8" sample of materials showing weave, finish, color, as selected.

B. Manufacturer's written installation instructions.

C. Certification that materials delivered and installed at the job conforms with specifications and referenced standards.

1.3 DELIVERY, STORAGE and HANDLING

A. Deliver shades wrapped and crated in a manner to prevent damage to components or marring of surfaces.

B. Store in a clean, dry area, laid flat and blocked off ground to prevent sagging, twisting, or warping.

C. Replace any damaged items or parts at no cost to the Owner.

1.4 COORDINATION

A. Window treatment mounting backing and other attachment backing is required to be installed during the framing stages of the work. Closely coordinate placement of blocking with framing operation to insure secure attachment of window treatment housing and accessories

1.5 MEASUREMENTS

A. Contractor shall field measure all openings and verify all details as indicated on the Drawings

PART 2 – PRODUCT

2.1 MANUFACTURER

A. Specification is based on MechoShade; similar products of SWF Contract, Draper, Hunter Douglas or prior approved subject to meeting requirements of these specifications.

2.2 MATERIALS

A. Window Treatment WT-1: Mechoshade System Inc., "Mecho/7" manual sunscreen system with SOHO 110 series 1% open basket weave sunscreen. Color as selected from manufacture's standard colors. Provide with large tube to accommodate for future motorized option.

B. Materials and Construction:

1. Shades shall meet the requirements of Federal Specification CCC-C-521E for fire retardancy. Flame spread 17, smoke density 118.

2. Pre-engineered unit with one piece molded sprockets and a linear disk brake opposed to a flat steel backing plate and concealed variable-adjustment mechanism. Shade mechanism shall be adjustable from 100% friction (static mode) with infinite positions to 15% friction (dynamic mode) with only pre-selected positions. The operator shall be a side-mounted gear and sprocket mechanism located within the drive-end bracket. The shade cloth shall be removable with a snap-on and snap-off mounting (SnapLoc™) spline without having to remove the shade tube.

3. Extruded aluminum pocket with exposed tile support and pocket closure. Head box finish shall be clear anodized aluminum to match the window system. Accessibility by removing closure. No exposed screws or mounting means. Pocket shall be sized for single shadeband. Extruded aluminum SnapLoc™ fascia which continuously fits on the end and center brackets as a one-piece section over two or more shadebands.

C. Accessory Hardware - Type(s) recommended by manufacturer.

2.3 SCHEDULE

A. Exterior windows at Rooms indicated on the Room Finish Schedule.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that openings are ready to receive the work. Do not commence fabrication until field measurements are confirmed. Ensure structural supports are correctly placed. Beginning of installation means installer accepts existing substrate

3.2 INSTALLATION

A. Install shades in accordance with manufacturer's instructions, inside opening installation.

B. Secure in place with concealed fasteners.

C. Tolerances: Maximum Variation of Gap at Window Opening Perimeter: 1/4".

D. Maximum Offset from Level: 1/8".

3.3 ADJUSTING and CLEANING

A. Adjust window treatment for smooth operation.

B. Clean work prior to Completion.

END OF SECTION 12 21 00

SECTION 13 21 26 – WALK-IN COOLERS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Provide all the walk-in cooler structure; insulated wall and ceiling panels, doors, refrigeration, lighting, flashings, closer strips, accessories and appurtenances, etc. as required to provide a complete, structurally sound, refrigerated, and weathertight building.

B. Walk in cooler to maintain temperature of 35 degrees at a 95 degree ambient temperature.

1.2 STANDARDS

A. In addition to complying with all pertinent codes and regulations, conform to various standards, specifications and/or interpretations and recommendations of professionally recognized agencies and groups, as the basis for establishing the design, fabrication, and quality criteria, standards, practices, methods and tolerances.

B. Construction shall conform, as applicable, to the requirements of the National Sanitation Foundation (NSF) Testing Laboratory, Underwriters Laboratories (UL), and Class One Building Type construction of Factory Mutual Approval Standard #4880 for insulated wall construction and shall be listed on panels for cold rooms applications.

1.3 SUBMITTALS

A. Submit drawings and manufacturers' literature per DIVISION 1 for Architect's review. Drawings shall show sizes, methods of construction and connections to adjacent members, gauges and methods of installation.

1.4 GUARANTEE

1. Per GENERAL CONDITIONS, provide manufacturers' standard guarantee for a minimum of 1 year which warrants building materials, components and accessories to be free from defects in material and workmanship.

2. In addition to the guarantee listed above, provide 5-year guarantee for compressor-motor (parts only).

1.5 QUALITY ASSURANCE

A. Workmanship:

1. Use only personnel who are thoroughly trained, certified and experienced in the skills required and who are completely familiar with the manufacturers' recommended methods of installation as well as the requirements of this work.

1.6 DELIVERY, HANDLING and STORAGE

A. Deliver, store and handle all components in a manner to prevent damage and deterioration.

B. Use all means necessary to protect the installed work and materials of all other trades.

C. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

1.7 JOB CONDITIONS

A. Coordination:

1. Coordinate work with all other trades to prevent delays in Work and to include all interphases with various other components, materials, etc.

B. Inspection:

1. Examine all other portions of this Project to verify that they are in proper condition to commence work of this Section.

PART 2 – PRODUCT

2.1 MANUFACTURER

A. Manufacturers

1. Design is based on products manufactured by CrownTonka (by Everidge). Other well-known established walk-in cooler manufacturers require prior approval.

2.2 MATERIALS

A. Walk-in Cooler Panels:

1. Wall and ceiling panels shall consist of inner and outer metal skins 26 gauge galvanized embossed white, 4" UL listed class 1 foam, R-25 or greater, and be equipped with cam-action locking devices. The resultant tongue and groove joint shall be sealed at both sides by double barreled NSF approved gaskets. In order to avoid future swelling and mold formation, no wood shall be permitted in the manufacture of the tongue and groove panel profile. Lag down wall to ceiling. Alignment strips for 4" foam rail, and field installed trim caps.

B. Doors:

1. 48" x 84" hinged, self-close overlap cooler doors, 26 gauge galvanized embossed white metal skins, 4" UL listed class 1 foam, R-25 or greater.

2. Strip curtain with necessary blocking.

3. Door hardware to consist of magnetic gasket, Kason #487-C frost free push handle, Kason #1248 hinges, Kason #1094 hydraulic door closers (concealed mounting), and floorless threshold.

C. Refrigeration:

1. Heatcraft model #LCH0025MCACZA0000, 2.5 horsepower compressor, medium temp air-cooled scroll condensing unit with microchannel condenser, liquid line filter/drier and sight glass 208-230/1/60, and R448/R449 refrigerant.

2. Heatcraft model #LEC0175AS7AMAB0200 evap. coil, air defrost center mount coil (unit cooler) with EC fan motors, electric expansion, valve and uNelliGen controller, coil, 115/1/60

3. Two (2) #1967-2 digital thermometer with switch.

D. Lighting:

1. Three (3) LED 45w, 48" lights

E. Miscellaneous:

1. Include all required trims, butyl, caulking, etc.

PART 3 – EXECUTION

3.1 INSPECTION

A. Before the start of installation, Contractor shall carefully inspect installed work of other trades affecting construction of the pre-engineered structure. Verify that all work is complete to the point where installation of the structure may properly commence.

B. Verify that the work of this section may be installed in accordance with all applicable codes and regulations, and with original design and as shown and indicated on the shop drawings.

C. Discrepancies:

1. In the event of a discrepancy, installer shall immediately notify the Architect. Installation shall not proceed until discrepancies and/or unsatisfactory conditions have been fully resolved and/or approved as agreed by Architect.

3.2 FABRICATION

A. Construction shall be as approved by the NSF International and shall bear the NSF Seal of Approval.

3.3 CLEAN UP and PATCHING

A. Contractor shall clean all walk-in cooler elements and components.

B. At the completion of Work, remove trash, debris, and all excess materials, cartons and/or items so that all areas of work are clean.

C. Provide protective measures, as required, so the walk-in cooler is without damage or deterioration at the time of Substantial Completion.

END OF SECTION 13 34 19

SPECIFICATION STAMP PAGE

DATE: **01/06/25**
PROJECT: **Chelan County Olds Campus**
ENGINEER: **Mark Kartchner, P.E., LEED**

DIVISION 22 – PLUMBING

DIVISION 23 – MECHANICAL

END OF INDEX

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 NEMA MG 1 unless otherwise indicated.

B. 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: Energy 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. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Class B.

H. Insulation: Class F.

I. 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.

J. 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. Energy- and 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 220513

SECTION 220517 - SLEEVES AND SLEEVE SEALS 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. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

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. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

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 Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping 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: Carbon steel, with corrosion-resistant coating, or Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

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. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. 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.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. 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 firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6: Cast-iron or galvanized pipe or wall sleeves.
b. Piping **NPS 6** and Larger: Cast-iron or galvanized pipe or wall sleeves.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Cast-iron or galvanized wall sleeves with sleeve-seal system.
b. Piping **NPS 6** and Larger: : Cast-iron or galvanized wall sleeves with sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than [**NPS 6**] <**Insert pipe size**>: [**Cast-iron wall sleeves with sleeve-seal system**] [**Galvanized-steel wall sleeves with sleeve-seal system**] [**Galvanized-steel-pipe sleeves with sleeve-seal system**] [**Sleeve-seal fittings**] <**Insert material**>.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping [**NPS 6**] <**Insert pipe size**> and Larger: [**Cast-iron wall sleeves with sleeve-seal system**] [**Galvanized-steel wall sleeves with sleeve-seal system**] [**Galvanized-steel-pipe sleeves with sleeve-seal system**] [**Galvanized-steel-pipe sleeves**] <**Insert material**>.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than [**NPS 6**] <**Insert pipe size**>: [**Galvanized-steel-pipe sleeves**] [**PVC-pipe sleeves**] [**Stack-sleeve fittings**] [**Sleeve-seal fittings**] [**Molded-PE or -PP sleeves**] [**Molded-PVC sleeves**] <**Insert material**>.
b. Piping [**NPS 6**] <**Insert pipe size**> and Larger: [**Galvanized-steel-pipe sleeves**] [**PVC-pipe sleeves**] [**Stack-sleeve fittings**] <**Insert material**>.

5. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves or PVC-pipe sleeves where allowed by code.
b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS 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. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

2. Escutcheons for Existing Piping:

a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.
f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

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. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.

B. Related Sections:

1. Section 221113 "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
2. Section 221116 "Domestic Water Piping" for water meters inside the building.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

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. Flo Fab Inc.
    b. Miljoco Corporation.
    c. Tel-Tru Manufacturing Company.
    d. Trerice, H. O. Co
    e. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    f. Weiss Instruments, Inc.
    g. WIKA Instrument Corporation - USA.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 6-inch nominal size.
4. Case Form: Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
9. Design for Thermowell Installation: Bare stem.
10. Connector: 3/4 inch, with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:

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. Flo Fab Inc.
    b. Miljoco Corporation.
    c. Tel-Tru Manufacturing Company.
    d. Trerice, H. O. Co
    e. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    f. Weiss Instruments, Inc.
    g. WIKA Instrument Corporation - USA.

2. Standard: ASME B40.200.
3. Case: Plastic; 6-inch nominal size.
4. Case Form: Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
9. Design for Thermowell Installation: Bare stem.
10. Connector: 3/4 inch, with ASME B1.1 screw threads.

11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

C. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

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. Flo Fab Inc.
    b. Miljoco Corporation.
    c. Palmer Wahl Instrumentation Group.
    d. Tel-Tru Manufacturing Company.
    e. Trerice, H. O. Co.
    f. Weiss Instruments, Inc.
    g. Winters Instruments - U.S.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass or plastic.
8. Stem: Aluminum and of length to suit installation.
9. Design for Thermowell Installation: Bare stem.
10. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

D. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

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. Ernst Flow Industries.
    b. Marsh Bellofram.
    c. Miljoco Corporation.
    d. Palmer Wahl Instrumentation Group.
    e. REOTEMP Instrument Corporation.
    f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    g. Weiss Instruments, Inc.
    h. WIKA Instrument Corporation - USA.

2. Standard: ASME B40.200.
3. Case: Plastic; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.

7. Window: Glass or plastic.
8. Stem: Aluminum, brass, or stainless steel and of length to suit installation.
9. Design for Thermowell Installation: Bare stem.
10. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES or CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

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. AMETEK, Inc.; U.S. Gauge.
b. Ashcroft Inc.
c. Ernst Flow Industries.
d. Flo Fab Inc.
e. Marsh Bellofram.
f. Miljoco Corporation.
g. Noshok.
h. Palmer Wahl Instrumentation Group.
i. REOTEMP Instrument Corporation.
j. Tel-Tru Manufacturing Company.
k. Trerice, H. O. Co.
l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
m. Weiss Instruments, Inc.
n. WIKA Instrument Corporation - USA.

o. Winters Instruments - U.S.

2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 6-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal or Brass.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

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. AMETEK, Inc.; U.S. Gauge.
b. Ashcroft Inc.
c. Flo Fab Inc.
d. Marsh Bellofram.
e. Miljoco Corporation.
f. Noshok.
g. Palmer Wahl Instrumentation Group.
h. REOTEMP Instrument Corporation.
i. Tel-Tru Manufacturing Company.
j. Trerice, H. O. Co.
k. Weiss Instruments, Inc.
l. WIKA Instrument Corporation - USA.
m. Winters Instruments - U.S.

2. Standard: ASME B40.100.
3. Case: Sealed type; plastic; 6-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass ball or Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

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. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.
4. Inlet and outlet of each remote domestic water chiller.

L. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
1. Compact or Industrial-style, liquid-in-glass type.

B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be the following:
1. Compact or Industrial-style, liquid-in-glass type.

C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be the following:
1. Compact or Industrial-style, liquid-in-glass type.

D. Thermometers at inlet and outlet of each remote domestic water chiller shall be the following:
   1. Compact or Industrial-style, liquid-in-glass type.

E. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F

B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be[**one of**] the following:

   1. Liquid-filled, direct-mounted, metal case.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:

   1. Liquid-filled, direct-mounted, metal case.

C. Pressure gages at suction and discharge of each domestic water pump shall be the following:

   1. Liquid-filled, direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 200 psi.

B. Scale Range for Domestic Water Piping: 0 to 100 psi.

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. Section Includes:

1. Bronze angle valves.
2. Brass ball valves.
3. Bronze ball valves.
4. Bronze lift check valves.
5. Bronze swing check valves.

B. Related Sections:

1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
3. Section 221319 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.
4. Section 221513 "General-Service Compressed-Air Piping" for valves applicable only to this piping.

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 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
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 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. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
5. 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 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, Bronze Angle Valves with Nonmetallic Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.

2. 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: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

C. Class 150, Bronze Angle Valves with Bronze Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 300 psig.

c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.
h.

D. Class 150, Bronze Angle Valves with Nonmetallic Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

2.3 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. DynaQuip Controls.
d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
e. Hammond Valve.
f. Jamesbury; a subsidiary of Metso Automation.
g. Jomar International, LTD.
h. Kitz Corporation.

i. Legend Valve.
j. Marwin Valve; a division of Richards Industries.
k. Milwaukee Valve Company.
l. NIBCO INC.
m. Red-White Valve Corporation.
n. RuB Inc.

2. 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.

B. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
d. Hammond Valve.
e. Jamesbury; a subsidiary of Metso Automation.
f. Kitz Corporation.
g. Marwin Valve; a division of Richards Industries.
h. Milwaukee Valve Company.
i. RuB Inc.

2. 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: Stainless steel.
i. Ball: Stainless steel, vented.

j. Port: Full.

2.4 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

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. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Hammond Valve.
e. Lance Valves; a division of Advanced Thermal Systems, Inc.
f. Legend Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Red-White Valve Corporation.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

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. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Lance Valves; a division of Advanced Thermal Systems, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.5 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

B. Class 125, Lift Check Valves with Nonmetallic Disc:

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. Flo Fab Inc.
b. Hammond Valve.
c. Kitz Corporation.
d. Milwaukee Valve Company.
e. Mueller Steam Specialty; a division of SPX Corporation.
f. NIBCO INC.
g. Red-White Valve Corporation.

h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: NBR, PTFE, or TFE.

2.6 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

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. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. 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.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: PTFE or TFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

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. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.
i. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Hammond Valve.
    d. Milwaukee Valve Company.
    e. NIBCO INC.
    f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 4.
    b. CWP Rating: 300 psig.
    c. Body Design: Horizontal flow.
    d. Body Material: ASTM B 62, bronze.
    e. Ends: Threaded.
    f. Disc: PTFE or TFE.

2.7 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, brass or bronze with brass trim.
3. Bronze Lift Check Valves: Class 125, nonmetallic disc.
4. Bronze Swing Check Valves: Class 150, nonmetallic disc.
5. Bronze Gate Valves: Class 150, NRS.

2.8 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG)

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, brass or bronze with brass trim.
3. Bronze Lift Check Valves: Class 125, nonmetallic disc.
4. Bronze Swing Check Valves: Class 150, nonmetallic disc.
5. Bronze Gate Valves: Class 150, NRS.

2.9 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 150, nonmetallic disc.
3. Ball Valves: Two piece, full port, brass or bronze with brass or bronze trim.
4. Bronze Swing Check Valves: Class 150, bronze or nonmetallic disc.
5. Bronze Gate Valves: Class 150, NRS.

B.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

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] [, gate, or plug] valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: [Globe] [Globe or angle] [or ball] [or butterfly] [, ball, or butterfly] valves.
4. Pump-Discharge Check Valves:

    a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
    b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
    c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

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 Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

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. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers 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 trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel 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.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

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. Allied Tube & Conduit.
b. Cooper B-Line, Inc.
c. Flex-Strut Inc.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut Corporation; Tyco International, Ltd.
g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.

5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
7. Metallic Coating: Electroplated zinc.
8. Paint Coating: Epoxy.

B. Non-MFMA Manufacturer Metal Framing Systems:

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; a subsidiary of Mueller Water Products Inc.
   b. Empire Industries, Inc.
   c. ERICO International Corporation.
   d. Haydon Corporation; H-Strut Division.
   e. NIBCO INC.
   f. PHD Manufacturing, Inc.
   g. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Zinc or Paint.

2.4 THERMAL-HANGER SHIELD INSERTS

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. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

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.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-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 INSTALLATION

A. Metal 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 the building structure.

B. Metal 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 for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

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 powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. 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-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. 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.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. 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.

M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Insulated Piping:

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 allowed by 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.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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 bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 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/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.4 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.

3.5 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 a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. 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 up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. 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.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. 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.

M. 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. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. 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.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.
b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220533 - HEAT TRACING 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 plumbing piping heat tracing for freeze prevention, domestic hot-water-temperature maintenance, and snow and ice melting on roofs and in gutters and downspouts with the following electric heating cables:

1. Plastic insulated, series resistance.
2. Self-regulating, parallel resistance.
3. Constant wattage.

B. Related Requirements:

1. Section 210533 "Heat Tracing for Fire-Suppression Piping."
2. Section 230533 "Heat Tracing for HVAC Piping."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric heating cable.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

1. Warranty Period: [**Three**] [**Five**] <**Insert number**> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLASTIC-INSULATED, SERIES-RESISTANCE HEATING CABLES

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:

1. Delta-Therm Corporation.
2. Easy Heat; a division of EGS Electrical Group LLC.
3. Orbit Manufacturing.
4. Pyrotenax; a brand of Tyco Thermal Controls LLC.
5. Raychem; a brand of Tyco Thermal Controls LLC.
6. WarmlyYours Inc.
7. Watts Radiant, Inc.; a subsidiary of Watts Water Technologies, Inc.
8. <**Insert manufacturer's name**>.

C. Comply with IEEE 515.1.

D. Heating Element: Single- or dual-stranded resistor wire. Terminate with waterproof, factory-assembled, nonheating leads with connectors at both ends.

E. Electrical Insulating Jacket: Minimum 4.0-mil (0.10-mm) Kapton with silicone, Tefzel, or polyolefin.

F. Cable Cover: Aluminum braid[**and silicone or Hylar outer jacket**].

G. Maximum Operating Temperature (Power On): [**300 deg F (150 deg C)**] <**Insert temperature**>.

H. Maximum Exposure Temperature (Power Off): [**185 deg F (85 deg C)**] <**Insert temperature**>.

I. 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.

J. Capacities and Characteristics:

1. Maximum Heat Output: [**6 W/ft. (19.7 W/m)**] [**7.5 W/ft. (24.6 W/m)**] <**Insert value**>.
2. Piping Diameter: <**Insert NPS (DN)**>.
3. Number of Parallel Cables: <**Insert number**>.
4. Spiral Wrap Pitch: <**Insert inches (mm)**>.
5. Electrical Characteristics for Single-Circuit Connection:

    a. Volts: [**120**] [**208**] [**240**] [**277**] [**480**] <**Insert value**>.
    b. Phase: <**Insert value**>.
    c. Hertz: <**Insert value**>.
    d. Full-Load Amperes: <**Insert value**>.
    e. Minimum Circuit Ampacity: <**Insert value**>.
    f. Maximum Overcurrent Protection: <**Insert amperage**>.

2.2 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:

1. BriskHeat.
2. Chromalox.
3. Delta-Therm Corporation.
4. Easy Heat; a division of EGS Electrical Group LLC.
5. Nelson Heat Trace; a division of EGS Electrical Group LLC.
6. Pyrotenax; a brand of Tyco Thermal Controls LLC.
7. Raychem; a brand of Tyco Thermal Controls LLC.
8. Thermon Americas Inc.
9. Trasor Corp.
10. <**Insert manufacturer's name**>.

C. Comply with IEEE 515.1.

D. Heating Element: Pair of parallel [**No. 16**] [**No. 18**] AWG, [**tinned**] [**nickel-coated**], stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

E. Electrical Insulating Jacket: Flame-retardant polyolefin.

F. Cable Cover: [**Tinned-copper**] [**Stainless-steel**] braid[**and polyolefin outer jacket with ultraviolet inhibitor**].

G. Maximum Operating Temperature (Power On): [**150 deg F (65 deg C)**] <**Insert temperature**>.

H. Maximum Exposure Temperature (Power Off): [**185 deg F (85 deg C)**] <**Insert temperature**>.

I. 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.

J. Capacities and Characteristics:

1. Maximum Heat Output: [**3 W/ft. (9.8 W/m)**] [**5 W/ft. (16.4 W/m)**] [**8 W/ft. (26 W/m)**] [**10 W/ft. (32.8 W/m)**] [**12 W/ft. (39.4 W/m)**] <**Insert value**>.
2. Piping Diameter: <**Insert NPS (DN)**>.
3. Number of Parallel Cables: <**Insert number**>.
4. Spiral Wrap Pitch: <**Insert inches (mm)**>.
5. Electrical Characteristics for Single-Circuit Connection:

    a. Volts: [**120**] [**208**] [**240**] [**277**] [**480**] <**Insert value**>.
    b. Phase: <**Insert value**>.
    c. Hertz: <**Insert value**>.
    d. Full-Load Amperes: <**Insert value**>.
    e. Minimum Circuit Ampacity: <**Insert value**>.
    f. Maximum Overcurrent Protection: <**Insert amperage**>.

2.3 CONSTANT-WATTAGE HEATING CABLES

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:

1. BriskHeat.
2. Chromalox.
3. Delta-Therm Corporation.
4. Easy Heat; a division of EGS Electrical Group LLC.
5. Nelson Heat Trace; a division of EGS Electrical Group LLC.
6. Pyrotenax; a brand of Tyco Thermal Controls LLC.
7. Raychem; a brand of Tyco Thermal Controls LLC.
8. Thermon Americas Inc.
9. Trasor Corp.
10. <**Insert manufacturer's name**>.

C. Comply with IEEE 515.1.

D. Heating Element: Pair of parallel [**No. 12**] <**Insert gage**> AWG, [**tinned**] [**nickel-coated**], stranded copper bus wires with single-stranded resistor wire connected between bus wires. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight.

E. Electrical Insulating Jacket: Flame-retardant fluoropolymer.

F. Cable Cover: [**Tinned-copper**] [**Stainless-steel**] braid[**and polyolefin outer jacket with ultraviolet inhibitor**].

G. Maximum Operating Temperature (Power On): [**392 deg F (200 deg C)**] <**Insert temperature**>.

H. Maximum Exposure Temperature (Power Off): [**185 deg F (85 deg C)**] <**Insert temperature**>.

I. 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.

J. Capacities and Characteristics:

1. Maximum Heat Output: [**4 W/ft. (13.1 W/m)**] [**8 W/ft. (26 W/m)**] [**12 W/ft. (39.4 W/m)**] <**Insert value**>.
2. Electrical Characteristics for Single-Circuit Connection:

a. Volts: [**120**] [**208**] [**240**] [**277**] [**480**] <**Insert value**>.
b. Phase: <**Insert value**>.
c. Hertz: <**Insert value**>.
d. Full-Load Amperes: <**Insert value**>.
e. Minimum Circuit Ampacity: <**Insert value**>.
f. Maximum Overcurrent Protection: <**Insert amperage**>.

2.4 CONTROLS

A. Pipe-Mounted Thermostats for Freeze Protection:

1. Remote bulb unit with adjustable temperature range from [**30 to 50 deg F (minus 1 to plus 10 deg C)**] <**Insert temperature range**>.
2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
4. Corrosion-resistant, waterproof control enclosure.

B. Precipitation and Temperature Sensor for Snow Melting on Roofs and in Gutters:

1. [**Microprocessor-based**] [**Automatic**] control with manual on, automatic, and standby/reset switch.
2. Precipitation and temperature sensors shall sense the surface conditions of roof and gutters and shall be programmed to energize the cable as follows:

    a. Temperature Span: [**34 to 44 deg F (1 to 7 deg C)**] <**Insert temperature range**>.
    b. Adjustable Delay-Off Span: [**30 to 90**] <**Insert time**> minutes.
    c. Energize Cables: Following [**two**] <**Insert time**>-minute delay if ambient temperature is below set point and precipitation is detected.
    d. De-Energize Cables: On detection of a dry surface plus time delay.

3. Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and precipitation and temperature sensors.
4. Minimum 30-A contactor to energize cable or close other contactors.
5. Precipitation sensor shall be freestanding.
6. Provide relay with contacts to indicate operational status, on or off, for interface with central HVAC control-system workstation.

C. Programmable Timer for Domestic Hot-Water-Temperature Maintenance:

1. Microprocessor based.
2. Minimum of four separate schedules.
3. Minimum 24-hour battery carryover.
4. On-off-auto switch.
5. 365-day calendar with 20 programmable holidays.
6. Relays with contacts to indicate operational status, on or off, and for interface with central HVAC control-system workstation.

2.5 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Refer to Section 220553 "Identification for Plumbing Piping and Equipment."

C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils (0.08 mm) thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Install the following types of electric heating cable for the applications described:

1. Snow and Ice Melting on Roofs and in Gutters and Downspouts: [**Plastic-insulated, series-resistance**] [**Self-regulating, parallel-resistance**] [**Constant-wattage**] heating cable.
2. Temperature Maintenance for Domestic Hot Water: Self-regulating, parallel-resistance heating cable.

3.3 INSTALLATION

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.

B. Electric Heating-Cable Installation for Snow and Ice Melting on Roofs and in Gutters and Downspouts: Install on roof and in gutters and downspouts with clips furnished by manufacturer that are compatible with roof, gutters, and downspouts.

C. Electric Heating-Cable Installation for Freeze Protection for Piping:

1. Install electric heating cables after piping has been tested and before insulation is installed.
2. Install electric heating cables according to IEEE 515.1.
3. Install insulation over piping with electric cables according to Section 220719 "Plumbing Piping Insulation."
4. Install warning tape on piping insulation where piping is equipped with electric heating cables.

D. Electric Heating-Cable Installation for Temperature Maintenance for Domestic Hot Water:

1. Install electric heating cables after piping has been tested and before insulation is installed.
2. Install insulation over piping with electric heating cables according to Section 220719 "Plumbing Piping Insulation."
3. Install warning tape on piping insulation where piping is equipped with electric heating cables.

E. Set field-adjustable switches and circuit-breaker trip ranges.

3.4 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:

1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.

2. Test cables for electrical continuity and insulation integrity before energizing.
3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

D. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

E. Cables will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect installed heating cables, including nonheating leads, from damage during construction.

B. Remove and replace damaged heat-tracing cables.

END OF SECTION 220533

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.3 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. 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.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 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.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. 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, 1/8 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. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. 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. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. 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 incheshigh.

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: Aluminum, 0.032-inch or anodized aluminum, 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.

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: Approximately 4 by 7 inches.
2. Fasteners: Reinforced grommet and wire or string.
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. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

B. 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.

C. Pipe Label Color Schedule:

1. Domestic Water Piping:

a. Background Color: Green.
b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Cold Water: 2 inches, round.
b. Hot Water: 2 inches, round.

2. Valve-Tag Color:

a. Cold Water: Natural.
b. Hot Water: Natural.

3. Letter Color:

a. Cold Water: Black.
b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 22 07 19 - PLUMBING PIPING 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 insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

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

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. 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.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing 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 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.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 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.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping 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.

1.8 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 "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. 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. Pittsburgh Corning Corporation; Foamglas.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular 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. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

H. 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 I. 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.; SoftTouch Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Friendly Feel Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; SOFTR All-Service Duct Wrap.

I. 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. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.
    c. Knauf Insulation; 1000-Degree Pipe Insulation.
    d. Manson Insulation Inc.; Alley-K.
    e. 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.

J. Phenolic:

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. Kingspan Tarec Industrial Insulation NV; Koolphen K.
    b. Resolco International BV; Insul-phen.

2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.

4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: ASJ. Requirements are specified in "Factory-Applied Jackets" Article.

K. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular 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. Armacell LLC; Tubolit.
b. Nomaco Insulation; IMCOLOCK and NOMALOCK.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

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. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

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. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

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. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 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. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

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. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

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

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

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.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

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

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33.

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

F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
d. Mon-Eco Industries, Inc.; 22-25.

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

G. PVC Jacket Adhesive: Compatible with PVC jacket.

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; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

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

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

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. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.

b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
b. Eagle Bridges - Marathon Industries; 501.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
b. Eagle Bridges - Marathon Industries; 570.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

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. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass and Phenolic Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. 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. Thickness is indicated in field-applied jacket schedules.

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; Zeston.
   b. P.I.C. Plastics, Inc.; FG Series.
   c. Proto 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 fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Sheet and roll stock ready for shop or field sizing.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.

2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

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. Pittsburgh Corning Corporation; Pittwrap.
b. Polyguard Products, Inc.; Insulrap No Torch 125.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

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. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

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. ABI, Ideal Tape Division; 491 AWF FSK.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

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. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

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. ITW Insulation Systems; Gerrard Strapping and Seals.
    b. RPR Products, Inc.; Insul-Mate Strapping and Seals.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

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. C & F Wire.

2.11 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:

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. Engineered Brass Company.
    b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
    c. McGuire Manufacturing.
    d. Plumberex.
    e. Truebro; a brand of IPS Corporation.
    f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures,:

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. Truebro; a brand of IPS Corporation.
b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. 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. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. 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 piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of 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**] [**4 inches**] o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, 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. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
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.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "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.
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. 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 valves, unions, and equipment requiring removal of insulation for maintenance. 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.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of 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 services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, 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 cut sections of cellular-glass block insulation of same thickness as pipe 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. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. 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.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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 INSTALLATION OF MINERAL-FIBER INSULATION

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. Instead, 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.

3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of 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 services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. 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 cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. 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.

3.10 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube 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 polyolefin 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 polyolefin 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 cut sections of polyolefin pipe and sheet insulation to valve body.
2. 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.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK 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.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.12 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

    a. Finish Coat Material: Interior, flat, latex-emulsion size.

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.

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.14 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. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.15 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: 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.

2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

   a. Cellular Glass: 2 inches thick.
   b. Flexible Elastomeric: 2 inches thick.
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.17 INDOOR, 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. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:
   1. PVC: 20 mils thick.

3.18 OUTDOOR, 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. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

   1. None.

D. Piping, Exposed:
   1. Aluminum, Smooth or Corrugated: 0.024 inch thick.

3.19 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

SECTION 22 11 16 - 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, and fittings inside buildings.
2. Encasement for piping.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.5 FIELD 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 Construction Manager no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Construction Manager's written permission.

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.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

C. No grooved piping is allowed.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

G. Copper Pressure-Seal-Joint Fittings:

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. Elkhart Products Corporation.
   b. NIBCO Inc.
   c. Viega.

2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

H. Copper Push-on-Joint Fittings:

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. Victaulic Company.
b. Mueller.
c. Elkhart

2. Description:

a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

I. Copper-Tube, Extruded-Tee 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. T-Drill Industries Inc.

2. Description: Tee formed in copper tube according to ASTM F 2014.

2.3 PEX TUBE AND FITTINGS

A. PEX Distribution System: ASTM F 877, SDR 9 tubing.

B. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.

C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.

2.4 PEX-AL-PEX TUBE AND FITTINGS

A. PEX-AL-PEX Distribution System: ASTM F 1281 tubing.

B. Fittings for PEX-AL-PEX Tube: ASTM F 1281, metal-insert type with copper or stainless-steel crimp rings and matching PEX-AL-PEX tube dimensions.

2.5 PEX-AL-HDPE TUBE AND FITTINGS

A. PEX-AL-HPDE Distribution System: ASTM F 1986 tubing.

B. Fittings for PEX-AL-HDPE Tube: ASTM F 1986, metal-insert type with copper or stainless-steel crimp ring and matching PEX-AL-HDPE tube dimensions

2.6 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. 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.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.7 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural.

2.8 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.

C. Sleeve-Type Transition Coupling: AWWA C219.

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. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Piping Specialties Products.
c. Ford Meter Box Company, Inc. (The).
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc.; a Sensus company.
g. Viking Johnson.

D. Plastic-to-Metal Transition Fittings:

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. Charlotte Pipe and Foundry Company.
b. Harvel Plastics, Inc.
c. Spears Manufacturing Company.

2. Description:

a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:

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. Colonial Engineering, Inc.
b. NIBCO Inc.
c. Spears Manufacturing Company.

2. Description:

a. CPVC or PVC four-part union.
b. Brass threaded end.
c. Solvent-cement-joint or threaded plastic end.
d. Rubber O-ring.
e. Union nut.

2.9 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

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. Capitol Manufacturing Company; member of the Phoenix Forge Group.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. Jomar International.
e. Matco-Norca.
f. McDonald, A. Y. Mfg. Co.
g. Watts; a division of Watts Water Technologies, Inc.
h. Wilkins; a Zurn company.

2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

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. Capitol Manufacturing Company; member of the Phoenix Forge Group.
b. Central Plastics Company.
c. Matco-Norca.
d. Watts; a division of Watts Water Technologies, Inc.
e. Wilkins; a Zurn company.

2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

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. Advance Products & Systems, Inc.

b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

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. Elster Perfection Corporation.
b. Grinnell Mechanical Products; Tyco Fire Products LP.
c. Matco-Norca.
d. Precision Plumbing Products, Inc.
e. Victaulic Company.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "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 copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

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 for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

H. Install domestic water piping level without pitch and plumb.

I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

J. 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.

K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

L. Install piping to permit valve servicing.

M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install PEX piping with loop at each change of direction of more than 90 degrees.

Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

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. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: 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."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.

H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

I. 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.

J. Joints for PEX Piping: Join according to ASTM F 1807.

K. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.5 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 or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits, or nipples.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

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.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

J. Install supports for vertical stainless-steel piping every 15 feet.

K. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
5. NPS 6: 48 inches with 3/4-inch rod.
6. NPS 8: 48 inches with 7/8-inch rod.

L. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.

M. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 32 inches with 3/8-inch rod.

N. Install hangers for vertical PEX piping every 48 inches.

O. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 and Smaller: 48 inches with 3/8-inch rod.
2. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.
5. NPS 8: 48 inches with 7/8-inch rod.

P. Install supports for vertical PVC piping every 48 inches.

Q. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
5. NPS 6: 48 inches with 3/4-inch rod.
6. NPS 8: 48 inches with 7/8-inch rod.

R. Install supports for vertical PP piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.

S. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for 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 that required by plumbing code.
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.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

    a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    b. 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:

        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 authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

    c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
    d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

    a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
    b. 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.

c. 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.

d. 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 it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.

    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

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. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

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. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 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. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground domestic water piping, NPS 2 and smaller, shall be one of 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; copper push-on-joint fittings; and push-on joints.
4. CPVC, Schedule 80; socket fittings; and solvent-cemented joints.
5. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
6. PEX tube, NPS 1 and smaller; fittings for PEX tube; and crimped joints.
7. PVC, Schedule 80; socket fittings; and solvent-cemented joints.

E. 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. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
3. CPVC, Schedule 80; socket fittings; and solvent-cemented joints.
4. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
5. PVC, Schedule 80; socket fittings; and solvent-cemented joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

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. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose bibbs.
9. Wall hydrants.
10. Ground hydrants.
11. Post hydrants.
12. Drain valves.
13. Water-hammer arresters.
14. Air vents.
15. Trap-seal primer valves.
16. Trap-seal primer systems.
17. Specialty valves.
18. Flexible connectors.
19. Water meters.

B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 223200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Section 224300 "Medical Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
5. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
6. Section 224713 "Drinking Fountains" for water filters for water coolers.
7. Section 224716 "Pressure Water Coolers" for water filters for water coolers.

8. Section 224723 "Remote Water Coolers" for water filters for water coolers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: [125 psig] <**Insert value**> unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

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. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
b. Cash Acme; a division of Reliance Worldwide Corporation.
c. Conbraco Industries, Inc.
d. FEBCO; a division of Watts Water Technologies, Inc.
e. Rain Bird Corporation.
f. Toro Company (The); Irrigation Div.

g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

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: Rough bronze in mechanical rooms or outside and Chrome plated in all other locations unless noted otherwise.

B. Hose-Connection Vacuum Breakers:
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. Arrowhead Brass Products.
b. Cash Acme; a division of Reliance Worldwide Corporation.
c. Conbraco Industries, Inc.
d. Legend Valve.
e. MIFAB, Inc.
f. Prier Products, Inc.
g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:
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. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
b. Conbraco Industries, Inc.
c. FEBCO; a division of Watts Water Technologies, Inc.
d. Flomatic Corporation.
e. Toro Company (The); Irrigation Div.
f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: As scheduled.
6. Design Flow Rate: As scheduled.
7. Selected Unit Flow Range Limits: As Scheduled.

8. Pressure Loss at Design Flow Rate: As Scheduled.
9. Accessories:

    a. Valves: Ball type, on inlet and outlet.

D. Laboratory-Faucet Vacuum Breakers:
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.
    b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    c. Woodford Manufacturing Company; a division of WCM Industries, Inc.
    d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1035.
3. Size: NPS 1/4 or NPS 3/8 matching faucet size.
4. Body: Bronze.
5. End Connections: Threaded.
6. Finish: Chrome plated.

E. Spill-Resistant Vacuum Breakers:
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.
    b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Accessories:

    a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:
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. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
    b. Conbraco Industries, Inc.
    c. FEBCO; a division of Watts Water Technologies, Inc.
    d. Flomatic Corporation.
    e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: As scheduled.
6. Body: Bronze for NPS 2 and smaller; cast iron or steel with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check, Backflow-Prevention Assemblies:
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. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
    b. Conbraco Industries, Inc.
    c. FEBCO; a division of Watts Water Technologies, Inc.
    d. Flomatic Corporation.
    e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: **5 psig** maximum, through middle third of flow range.
5. Size: As scheduled.
6. Body: Bronze for NPS 2 and smaller; cast iron or steel with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Accessories:

    a. ValvesNPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. ValvesNPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

C. Beverage-Dispensing-Equipment Backflow Preventers:
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.
    b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.

4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

D. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:
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. Cash Acme; a division of Reliance Worldwide Corporation.
b. Lancer Corporation.
c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Standard: ASSE 1032.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

E. Reduced-Pressure-Detector, Fire-Protection, Backflow-Preventer Assemblies:
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. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
b. Conbraco Industries, Inc.
c. FEBCO; a division of Watts Water Technologies, Inc.
d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1047 and is FM Global approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: As scheduled.
6. Body: Cast iron or steel with interior lining that complies with AWWA C550 or that is FDA approved.
7. End Connections: Flanged.
8. Accessories:

a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

F. Double-Check, Detector-Assembly Backflow Preventers:
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. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.

b. Conbraco Industries, Inc.
c. FEBCO; a division of Watts Water Technologies, Inc.
d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1048 and is FM Global approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: As scheduled.
6. Body: Cast iron or steel with interior lining that complies with AWWA C550 or that is FDA approved.
7. End Connections: Flanged.
8. Accessories:

a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

G. Hose-Connection Backflow Preventers:
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.
b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
c. Woodford Manufacturing Company; a division of WCM Industries, Inc.

2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
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. Cash Acme; a division of Reliance Worldwide Corporation.
b. Conbraco Industries, Inc.
c. Honeywell International Inc.
d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: As scheduled.

5. Design Flow Rate: As scheduled.
6. Design Inlet Pressure: As scheduled.
7. Design Outlet Pressure Setting: As scheduled.
8. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing 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. Armstrong International, Inc.
b. Flo Fab Inc.
c. ITT Corporation; Bell & Gossett Div.
d. NIBCO Inc.
e. TAC.
f. TACO Incorporated.
g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
3. Body: Brass or bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing 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. Armstrong International, Inc.
b. Flo Fab Inc.
c. ITT Corporation; Bell & Gossett Div.
d. NIBCO Inc.
e. TAC.
f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Memory-Stop Balancing 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.
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.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing 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. Armstrong International, Inc.
b. Lawler Manufacturing Company, Inc.
c. Leonard Valve Company.
d. Powers; a division of Watts Water Technologies, Inc.
e. Symmons Industries, Inc.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psigminimum unless otherwise indicated.
4. Type: Exposed-mounted or cabinet-type as scheduled, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: As scheduled.
9. Valve Finish: Polished, chrome plated for exposed installations and rough bronze for cabinet mounted.
10. Piping Finish: Finish to match valve finish..
11. Cabinet: Factory fabricated, stainless steel, for recessed or surface mounting, as scheduled and with hinged, stainless-steel door.

B. Manifold, Thermostatic, Water Mixing-Valve Assemblies:

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

    a. Leonard Valve Company.
    b. Powers; a division of Watts Water Technologies, Inc.
    c. Symmons Industries, Inc.

2. Description: Factory-fabricated, exposed-mounted, thermostatically controlled, water mixing-valve assembly in two or three-valve parallel arrangement.
3. Large-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
4. Intermediate-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
5. Small-Flow Parallel: Thermostatic, water mixing valve.
6. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
7. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
8. Pressure Rating: 125 psig minimum unless otherwise indicated.
9. Thermostatic Mixing Valve and Water Regulator Finish: Rough bronze.
10. Piping Finish: Copper.

C. Individual-Fixture, Water Tempering 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. Cash Acme; a division of Reliance Worldwide Corporation.
    b. Conbraco Industries, Inc.
    c. Honeywell International Inc.
    d. Lawler Manufacturing Company, Inc.
    e. Leonard Valve Company.
    f. Powers; a division of Watts Water Technologies, Inc.
    g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: 105 deg F.

2.8 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; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.020 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
    c. Strainers NPS 5 and Larger: 0.10 inch.

6. Drain: Pipe plug.

2.9 OUTLET BOXES

A. Clothes Washer Outlet Boxes: WB-1
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. Acorn Engineering Company.
    b. Guy Gray Manufacturing Co., Inc.
    c. IPS Corporation.
    d. LSP Products Group, Inc.
    e. Oatey.
    f. Plastic Oddities.
    g. Symmons Industries, Inc.
    h. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    i. Whitehall Manufacturing; a div. of Acorn Engineering Company.
    j. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.

2. Mounting: Recessed.
3. Material and Finish: Enameled-steel, 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 ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.

B. Icemaker Outlet Boxes IB-1
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. Acorn Engineering Company.
    b. IPS Corporation.
    c. LSP Products Group, Inc.
    d. Oatey.
    e. Plastic Oddities.

2. Mounting: Recessed.
3. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 ball valve and NPS 1/2 copper, water tubing.

2.10 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or 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 or field-installation**,** nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish: Rough bronze, or chrome or nickel plated as scheduled.
9. Operation: Wheel handle.

2.11 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

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. 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.
    f. Woodford Manufacturing Company; a division of WCM Industries, Inc.
    g. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
    h. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASME A112.21.3M for concealed or exposed-outlet as scheduled, 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: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Chrome.

10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Chrome.
12. Operating Keys(s): Two with each wall hydrant.

B. Nonfreeze, Hot- and Cold-Water Wall Hydrants:
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. Josam Company.
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products.
    e. Woodford Manufacturing Company; a division of WCM Industries, Inc.
    f. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASME A112.21.3M for concealed or exposed as scheduled-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rods: Of length required to match wall thickness. Include wall clamps.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Chrome.
10. Vacuum Breaker:

    a. Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
    b. Garden-hose thread complying with ASME B1.20.7 on outlet.

11. Operating Keys(s): Two with each wall hydrant.

C. Moderate-Climate Wall Hydrants:
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. MIFAB, Inc.
    b. Prier Products, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products.
    f. Woodford Manufacturing Company; a division of WCM Industries, Inc.
    g. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
    h. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASME A112.21.3M for concealed or exposed-outlet as scheduled, self-draining wall hydrants.

3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Inlet: NPS 3/4 or NPS 1.
6. Outlet:

    a. Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
    b. Garden-hose thread complying with ASME B1.20.7.

7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: Chrome plated.
9. Outlet:

    a. Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
    b. Garden-hose thread complying with ASME B1.20.7.

10. Nozzle and Wall-Plate Finish: Polished nickel bronze.
11. Operating Keys(s): Two with each wall hydrant.

2.12 GROUND HYDRANTS

A. Nonfreeze Ground Hydrants:
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. Josam Company.
    b. MIFAB, Inc.
    c. Murdock-Super Secur; a division of Acorn Engineering Company.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products.
    g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
    h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
    i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASME A112.21.3M.
3. Type: Nonfreeze, concealed-outlet ground hydrant with box.
4. Operation: Loose key.
5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
6. Inlet: NPS 3/4.
7. Outlet: Garden-hose thread complying with ASME B1.20.7.
8. Drain: Designed with hole to drain into ground when shut off.
9. Box: Deep pattern with cover.
10. Box and Cover Finish: Rough bronze.

11. Operating Key(s): Two with each ground hydrant.
12. Vacuum Breaker: ASSE 1011.

2.13 POST HYDRANTS

A. Nonfreeze, Nondraining-Type Post Hydrants:
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. Josam Company.
b. MIFAB, Inc.
c. Murdock-Super Secur; a division of Acorn Engineering Company.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products.
g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Operation: Lever-piston operating mechanism and nondraining water-storage reservoir, designed without drain.
3. Length: As required for burial of valve below frost line.
4. Inlet: NPS 1 threaded.
5. Outlet:
a. NPS 1 by NPS 3/4 adapter with nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

B. Freeze-Resistant Sanitary Yard Hydrants:
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. Josam Company.
b. MIFAB, Inc.
c. Murdock-Super Secur; a division of Acorn Engineering Company.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products.
g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASSE 1057, Type 5 for nondraining hydrants.
3. Operation: Wheel handle.
4. Head: Copper alloy, with pail hook.
5. Inlet: NPS 3/4-inch threaded inlet and inlet nozzle, galvanized-steel riser, and venturi.
6. Canister: Plastic or Zinc-plated steel with atmospheric-vent device.
7. Vacuum Breaker:

a. Removable hose-connection backflow preventer complying with ASSE 1052.

b. Garden-hose thread complying with ASME B1.20.7 on outlet for field installation.

2.14 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.15 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

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. AMTROL, Inc.
b. Josam Company.
c. MIFAB, Inc.
d. Precision Plumbing Products, Inc.
e. Sioux Chief Manufacturing Company, Inc.
f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
g. Tyler Pipe; Wade Div.
h. Watts Drainage Products.
i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.16 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 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.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
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.

2.17 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:
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. MIFAB, Inc.
    b. Precision Plumbing Products, Inc.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:
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. MIFAB, Inc.
    b. Precision Plumbing Products, Inc.
    c. Sioux Chief Manufacturing Company, Inc.

d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

2.18 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:
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. MIFAB, Inc.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Standard: ASSE 1044.
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Recessed-mounted steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.

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.

6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: Four, Six, or Eight**.**
8. Size Outlets: NPS 1/2.

2.19 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. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld Incorporated.
5. Hyspan Precision Products, Inc.
6. Mercer Gasket & Shim, Inc.
7. Metraflex, Inc.
8. Proco Products, Inc.
9. TOZEN Corporation.
10. Unaflex.Universal Metal Hose; a Hyspan company.

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 250 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.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 250 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.20 WATER METERS

A. Displacement-Type Water Meters:
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. AALIANT; a Venture Measurement product line.ABB.Badger Meter, Inc.
b. Carlon Meter.
c. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
d. Schlumberger Limited; Water Services.
e. Sensus.

2. Description:

a. Standard: AWWA C700.
b. Pressure Rating: 150-psig working pressure.
c. Body Design: Nutating disc; totalization meter.
d. Registration: In gallons or cubic feet as required by utility company.
e. Case: Bronze.
f. End Connections: Threaded.

B. Turbine-Type Water Meters:
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. AALIANT; a Venture Measurement product line.
b. ABB.
c. Badger Meter, Inc.
d. Hays Fluid Controls.
e. Master Meter, Inc.
f. McCrometer, Inc.
g. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
h. Schlumberger Limited; Water Services.

i. SeaMetrics Inc.
j. Sensus.

2. Description:

a. Standard: AWWA C701.
b. Pressure Rating: 150-psig working pressure.
c. Body Design: Turbine; totalization meter.
d. Registration: In gallons or cubic feet as required by utility company.
e. Case: Bronze.
f. End Connections for Meters NPS 2 and Smaller: Threaded.
g. End Connections for Meters NPS 2-1/2 and Larger: Flanged.

C. Compound-Type Water Meters:
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. ABB.
b. Badger Meter, Inc.
c. Master Meter, Inc.
d. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
e. Schlumberger Limited; Water Services.
f. Sensus.

2. Description:

a. Standard: AWWA C702.
b. Pressure Rating: 150-psig working pressure.
c. Body Design: With integral mainline and bypass meters; totalization meter.
d. Registration: In gallons or cubic feet as required by utility company.
e. Case: Bronze.
f. Pipe Connections: Flanged.

D. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

E. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. 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 unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Install water-control valves with inlet and outlet shutoff valves and bypass with globe 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.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

I. Install ground hydrants with 1 cu. yd**.** of crushed gravel around drain hole. Set ground hydrants with box flush with grade.

J. Install draining-type post hydrants with 1 cu. yd**.** of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft**.** of concrete block at grade.

K. Set nonfreeze, nondraining-type post hydrants in concrete or pavement.

L. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.

M. Install water-hammer arresters in water piping according to PDI-WH 201.

N. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

O. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

P. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

Q. 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. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
4. Double-check, backflow-prevention assemblies.
5. Carbonated-beverage-machine backflow preventers.
6. Dual-check-valve backflow preventers.
7. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
8. Double-check, detector-assembly backflow preventers.
9. Water pressure-reducing valves.
10. Calibrated balancing valves.
11. Primary, thermostatic, water mixing valves.
12. Manifold, thermostatic, water mixing-valve assemblies.
13. Photographic-process, thermostatic, water mixing-valve assemblies.
14. Primary water tempering valves.
15. Outlet boxes.
16. Hose stations.
17. Supply-type, trap-seal primer valves.

18. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly, and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 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 221123 - DOMESTIC WATER 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. Section Includes:

1. In-line, sealless centrifugal pumps.
2. Horizontally mounted, in-line, separately coupled centrifugal pumps.
3. Horizontally mounted, in-line, close-coupled centrifugal pumps.
4. Vertically mounted, in-line, close-coupled centrifugal pumps.

B. Related Sections include the following:

1. Section 221123.13 "Domestic-Water Packaged Booster Pumps" for booster systems.
2. Section 332100 "Water Supply Wells" for well pumps.

1.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, without amendments, Section 7 - "Service Water Heating."

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.6 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

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

1. Armstrong Pumps Inc.
2. Bell & Gossett Domestic Pump; ITT Corporation.
3. Grundfos Pumps Corp.
4. TACO Incorporated.
5. WILO USA LLC - WILO Canada Inc.

B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, seal-less, overhung-impeller centrifugal pumps.

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.

D. Capacities and Characteristics:
1. As scheduled on the drawings

2.2 HORIZONTALLY MOUNTED, IN-LINE, SEPARATELY COUPLED CENTRIFUGAL PUMPS

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

1. Bell & Gossett Domestic Pump; ITT Corporation.
2. Marshall Engineered Products Co.
3. TACO Incorporated.
4. Thrush Co. Inc.
5. Weinman Division; Crane Pumps & Systems.

B. Description: Factory-assembled and -tested, in-line, single-stage, separately coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shafts mounted horizontal.

C. Pump Construction:

1. Casing: Radially split with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
3. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
4. Coupling: Flexible.
5. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
6. Bearings: Oil-lubricated; bronze-journal or ball type.
7. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.

D. Motor: Single speed, with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.

E. Capacities and Characteristics:
1. As scheduled on the drawings

2.3 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

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

1. Armstrong Pumps Inc.
2. Bell & Gossett Domestic Pump; ITT Corporation.
3. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
4. Pentair Pump Group; Aurora Pump.
5. TACO Incorporated.
6. Thrush Company, Inc.

B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.

C. Pump Construction:

1. Casing: Radially split with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
5. Bearings: Oil-lubricated; bronze-journal or ball type.
6. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.

D. Motor: Single speed, with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.

E. Capacities and Characteristics:
1. As scheduled on the drawings

2.4 VERTICALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

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

1. Armstrong Pumps Inc.
2. Bell & Gossett Domestic Pump; ITT Corporation.
3. Federal Pump Corp.
4. Grundfos Pumps Corp.
5. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
6. Peerless Pump, Inc.
7. Pentair Pump Group; Aurora Pump.

8. TACO Incorporated.

B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted vertical.

C. Pump Construction:

1. Casing: Radially split, cast iron, with wear rings and threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections. Include pump manufacturer's base attachment for mounting pump on concrete base.
2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
3. Shaft and Shaft Sleeve: Stainless-steel shaft, with copper-alloy shaft sleeve.
4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
5. Bearings: Oil-lubricated; bronze-journal or ball type.
6. Shaft Coupling: Flexible or rigid type if pump is provided with coupling.

D. Motor: Single speed, with grease-lubricated ball bearings; and rigidly mounted to pump casing.

E. Capacities and Characteristics:
1. As scheduled on the drawings

2.5 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing 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.

2.6 CONTROLS

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.

1. Type: Water-immersion temperature sensor, for installation in piping.
2. Range: 65 to 200 deg F.
3. Operation of Pump: On or off.
4. Transformer: Provide if required.
5. Settings: Start pump at 110 deg F and stop pump at 130 deg F.

B. Timers: Electric, for control of hot-water circulation pump.

1. Type: Programmable, seven-day clock with manual override on-off switch.
2. Operation of Pump: On or off.
3. Transformer: Provide if required.
4. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.

C. Time-Delay Relays: Electric, for control of hot-water circulation pump between water heater and connected hot-water storage tank.

1. Type: Adjustable time-delay relay.
2. Range: Up to five minutes.
3. Setting: Five minutes.
4. Enclosure: NEMA 250, Type 4X.
5. Operation of Pump: On or off.
6. Transformer: Provide if required.
7. Programmable Sequence of Operation: Limit pump operation to periods of burner operation plus maximum five minutes after the burner stops.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.

C. Install horizontally mounted, in-line, separately coupled and close-coupled centrifugal pumps with shaft(s) horizontal.

D. Install vertically mounted, in-line, close-coupled centrifugal pumps with shaft vertical.

E. Pump Mounting: Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using elastomeric pads or elastomeric mounts on first floor or basement installations and restrained spring isolators on upper floor installations. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete." or Section 033053 "Miscellaneous Cast-in-Place Concrete."

1. Minimum Deflection: 1/4 inch on elastomeric isolators and 1 inch on restrained spring isolators.
2. 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.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

F. Install continuous-thread hanger rods and spring hangers of size required to support pump weight.

1. Comply with requirements for vibration isolation devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

G. Install pressure switches in water supply piping.

H. Install thermostats in hot-water return piping.

I. Install timers near pumps.

J. Install time-delay relays in piping between water heaters and hot-water storage tanks.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:

a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
c. Vertically mounted, in-line, close-coupled centrifugal pumps.
d. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."

2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties."
3. Install pressure gage at suction of each pump and pressure gage at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

D. Connect thermostats, time-delay relays, and timers to pumps that they control.

E. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

A. 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. Set pressure switches, thermostats, timers, and time-delay relays for automatic starting and stopping operation of pumps.
5. 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.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.6 ADJUSTING

A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123

SECTION 22 13 16 - 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.
3. Encasement for underground metal piping.

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.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 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.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

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 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping 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. ANACO-Husky.
b. Clamp-All Corp.
c. Dallas Specialty & Mfg. Co.
d. MIFAB, Inc.
e. Mission Rubber Company; a division of MCP Industries, Inc.
f. Stant.
g. Tyler Pipe.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 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. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

E. 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.

F. 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.

G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 ABS PIPE AND FITTINGS

A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

D. Solvent Cement: ASTM D 2235.

1. ABS solvent cement shall have a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 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. 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) Cascade Waterworks Mfg. Co.
2) Mission Rubber Company; a division of MCP Industries, Inc.

b. Standard: ASTM C 1460.
c. 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. 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) Cascade Waterworks Mfg. Co.
2) Dresser, Inc.
3) EBAA Iron, Inc.
4) JCM Industries, Inc.
5) Romac Industries, Inc.
6) Smith-Blair, Inc.; a Sensus company.
7) The Ford Meter Box Company, Inc.
8) Viking Johnson.

b. Standard: AWWA C219.
c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
d. Center-Sleeve Material: Manufacturer's standard.
e. Gasket Material: Natural or synthetic rubber.
f. 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. 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) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Hart Industries International, Inc.
4) Jomar International Ltd.
5) Matco-Norca, Inc.
6) McDonald, A. Y. Mfg. Co.
7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
8) Wilkins; a Zurn company.

b. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 125 psig minimum at 180 deg F.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

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) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Matco-Norca, Inc.
4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
5) Wilkins; a Zurn company.

b. 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. 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) Central Plastics Company.
4) Pipeline Seal and Insulator, Inc.

b. 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. 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) Elster Perfection.
2) Grinnell Mechanical Products.
3) Matco-Norca, Inc.
4) Precision Plumbing Products, Inc.
5) Victaulic Company.

b. Description:

1) Standard: IAPMO PS 66
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig at 225 deg F.
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 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 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. 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.

K. 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.

L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. 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."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

O. Install aboveground ABS piping according to ASTM D 2661.

P. Install aboveground PVC piping according to ASTM D 2665.

Q. Install underground ABS and PVC piping according to ASTM D 2321.

R. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "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 Section 221319 "Sanitary Waste Piping Specialties."
3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. 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.

B. 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.

C. 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. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. 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.
4. In Underground Force Main Piping:

    a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
    b. NPS 2 and Larger: Pressure 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 unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.

4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

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 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 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.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

I. Install supports for vertical copper tubing every 10 feet.

J. Install hangers for ABS and 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 ABS and PVC piping every 48 inches.

L. 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 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 with cleanout cover flush with floor.
6. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "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.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "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 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.

3.9 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.

D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
1. Hubless, cast-iron soil pipe and fittings and heavy-duty hubless-piping couplings; and coupled joints.
2. Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
3. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Hubless, cast-iron soil pipe and fittings and heavy-duty hubless-piping couplings; and coupled joints.
2. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.

2. Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.

3. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

E. Aboveground, vent piping NPS 5 and larger shall be any of the following:
1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
2. Galvanized-steel pipe, drainage fittings, and threaded joints.
3. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
2. Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
3. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; coupled joints.
2. Cellular-core PVC pipe; PVC socket fittings; and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be the following:

1. Hard copper tube, Type L; copper pressure fittings; and soldered 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. Section Includes:
1. Cleanouts.
2. Floor drains.
3. Roof flashing assemblies.
4. Through-penetration firestop assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.7 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.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete." or Section 033053 "Miscellaneous Cast-in-Place Concrete."

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

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) Josam Company.
2) MIFAB, Inc.
3) Smith, Jay R. Mfg. Co.
4) Tyler Pipe.
5) Watts Drainage Products.
6) Zurn Plumbing Products Group.

2. Standard: ASME A112.36.2M for cast iron, and ASME A112.3.1 for stainless steel for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee or Stainless-steel tee with side cleanout as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

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) Josam Company.
2) Oatey.
3) Sioux Chief Manufacturing Co., Inc.
4) Smith, Jay R. Mfg. Co.
5) Tyler Pipe.
6) Watts Drainage Products.
7) Zurn Plumbing Products Group.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk, Spigot, or Threaded.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Polished bronze.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall 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. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe; Wade Div.

e. Watts Drainage Products.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Commercial Enameling Co.
b. Josam Company; Josam Div.
c. MIFAB, Inc.
d. Prier Products, Inc.
e. Smith, Jay R. Mfg. Co.
f. Tyler Pipe; Wade Div.
g. Watts Drainage Products.
h. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASME A112.6.3.
3. Pattern: As scheduled.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Coating on Interior and Exposed Exterior Surfaces: As scheduled.
9. Sediment Bucket: As scheduled.
10. Top or Strainer Material: As Scheduled.
11. Top of Body and Strainer Finish: As scheduled.
12. Top Shape: Round or Square as scheduled.
13. Top Loading Classification: Medium Duty unless noted otherwise.
14. Funnel: As scheduled.
15. Trap Features: Trap-seal primer valve drain connection.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

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. Acorn Engineering Company; Elmdor/Stoneman Div.
   b. Thaler Metal Industries Ltd.

2. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

   a. Open-Top Vent Cap: Without cap.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

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. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

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.

E. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

H. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.

2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

I. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.6 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft..
2. Vent Pipe Flashing: 8 oz./sq. ft..

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.7 MOTORS

A. General requirements for motors are specified in Section 220513 "Common Motor Requirements for Plumbing 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. 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.
b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-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.

E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

F. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

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 sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

L. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

M. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

N. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

O. Install wood-blocking reinforcement for wall-mounting-type specialties.

P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Leak Test: After installation, charge system 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.

3.5 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 221323 - SANITARY WASTE INTERCEPTORS

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. Oil interceptors.
   2. Sand interceptors.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. HDPE: High density polyethylene.

C. PP: Polypropylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of [metal] [and] [plastic] interceptor. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

B. Shop Drawings: For each type and size of precast concrete interceptor indicated.

   1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

   1. Piping connections. Include size, location, and elevation of each.
   2. Interface with underground structures and utility services.

B. Warranty Documentation.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of HDPE interceptors 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 metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: Lifetime.

PART 2 - PRODUCTS

2.1 OIL INTERCEPTORS

A. Precast Concrete Oil Interceptors: Comply with [**ASTM C913**]

1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
2. Structural Design Loads:

a. Light-Traffic Load: Comply with ASTM C890, A-8.
b. Medium-Traffic Load: Comply with ASTM C890, A-12.
c. Heavy-Traffic Load: Comply with ASTM C890, A-16.
d. Walkway Load: Comply with ASTM C890, A-03.

3. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into interceptor walls, for each pipe connection.
4. Steps: [**Individual FRP steps or FRP ladder**] [**Individual FRP steps, FRP ladder, or ASTM A615/A615M, deformed,** 1/2-inch **(13-mm) steel reinforcing rods encased in ASTM D4101, PP**] [**ASTM A615/A615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D4101, 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- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of interceptor to finished grade is less than **60 inches (1500 mm)**.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover.

a. Ductile Iron: ASTM A536, Grade 60-40-18, unless otherwise indicated.
b. Gray Iron: ASTM A48/A48M, Class 35, unless otherwise indicated.
c. Include indented top design with lettering cast into cover, using wording equivalent to "**OIL INTERCEPTOR**."

7. Waste-oil storage tank and piping are specified in Section 231113 "Facility Fuel-Oil Piping."

B. Steel Oil Interceptors: Factory-fabricated; with removable sediment bucket or strainer, baffles, vents, and flow-control fitting on inlet.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MIFAB, Inc.; MI-O or comparable product by one of the following:

   a. Jay R. Smith Mfg. Co.
   b. Josam Company.

2. Inlet, Outlet, Vent, and Waste-Oil Outlet Piping Connections: No-Hub, unless otherwise indicated.
3. Extension: Steel shroud, full size of interceptor, extending from top of interceptor to grade.
4. Cover: Steel, with steel reinforcement to provide ASTM C890, [**A-03, walkway**] Medium to Heavy traffic load.
5. Comply with requirements in Section 231113 "Facility Fuel-Oil Piping" for waste-oil storage tank and piping.

C. Plastic Oil Interceptors: Removable sediment bucket or strainer, baffles, vents, and flow-control fitting on inlet.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MIFAB, Inc.; [**Lil Max, Model O**] [**Big Max, Model O**] [**SuperMax, Model O**] or comparable product by one of the following:

   a. Green Turtle Zurn.
   b. Town & Country Plastics, Inc.
   c. Striem.

2. Inlet, Outlet, Vent, and Waste-Oil Outlet Piping Connections: No-Hub, unless otherwise indicated.
3. Extension: **Plastic shroud extension 24-inch (600-mm) diameter ADS corrugated pipe extension**], extending from top of interceptor to grade.
4. Cover: Plastic[**with steel reinforcement to provide ASTM C890,**] [**A-03, walkway**] Medium to heavy load.
5. Waste-oil storage tank and piping are specified in Section 231113 "Facility Fuel-Oil Piping."

2.2 SAND INTERCEPTORS, STEEL

A. Description: Factory-fabricated, steel body[**and ductile iron inlet grate**]; with settlement chamber and removable basket or strainer.

B. Basis-of-Design Product: Subject to compliance with requirements, provide MIFAB, Inc.; MI-SAND or comparable product by one of the following:

1. Jay R. Smith Mfg. Co.
2. Josam Company.
3. Zurn.

C. Outlet Piping Connection: No-Hub, unless otherwise indicated.

D. Grate: Ductile iron with reinforcement to provide ANSI A112.21.1M Load Class, Special Duty, DIN 19580, Load Class E.

2.3 SAND INTERCEPTORS, PLASTIC

A. Description: Factory-fabricated, HDPE body and inlet grate; with settlement chamber and removable basket or strainer.

B. Basis-of-Design Product: Subject to compliance with requirements, provide MIFAB, Inc.; [**Lil-SA**] [**Lil-OS**] [**Big-SA**] [**Big-OS**] [**Super-SA**] [**Super-OS**] or comparable product by one of the following:

1. Jay R. Smith Mfg. Co.
2. Josam Company.
3. Zurn

C. Outlet Piping Connection: No-Hub unless otherwise indicated.

D. Grate: Cast ductile iron with reinforcement to provide ANSI A112.21.1M Load Class, Special Duty, DIN 19580, Load Class E.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 INSTALLATION

A. Equipment Mounting:

1. Install Oil interceptors, **sand interceptors** on cast-in-place concrete equipment base(s).
2. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

B. Install precast concrete interceptors in accordance with ASTM C891.

C. Set interceptors level and plumb.

D. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.

E. Set tops of manhole frames and covers flush with finished surface in pavements.

F. Set tops of grating frames and grates flush with finished surface.

G. Set **metal and plastic** interceptors level and plumb.

H. Set tops of metal interceptor covers flush with finished surface in pavements.

I. Install piping and oil storage tanks in accordance with Section 231113 "Facility Fuel-Oil Piping."

J. Install oil interceptors, including trapping, venting, and flow-control fitting, in accordance with authorities having jurisdiction and with clear space for servicing.

1. Coordinate oil-interceptor storage tank and gravity drain with Section 231113 "Facility Fuel-Oil Piping."

K. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet.

1. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make piping connections between interceptors and piping systems.

3.4 IDENTIFICATION

A. Identification materials and installation are specified in Section 312000 "Earth Moving."

1. Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
2. Use warning tapes or detectable warning tape over ferrous piping.
3. Use detectable warning tape over nonferrous piping and over edges of underground structures.

B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Oil interceptors.
2. Sand interceptors.

3.5 PROTECTION

A. Protect sanitary waste interceptors from damage during construction period.

B. Repair damage to adjacent materials caused by sanitary waste interceptor installation.

END OF SECTION 221323

SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR 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 piping and related specialties for general-service compressed-air systems operating at 200 psig or less.

B. Related Sections include the following:

1. Section 221519 "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. CR: Chlorosulfonated polyethylene synthetic rubber.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. HDPE: High-density polyethylene plastic.

E. NBR: Acrylonitrile-butadiene rubber.

F. PE: Polyethylene plastic.

G. PVC: Polyvinyl chloride plastic.

H. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 150 and 200 psig.

I. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Compressed-air piping and support and installation shall withstand effects of seismic events determined according to SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Plastic pipes, fittings, and valves.
2. Dielectric fittings.
3. Flexible pipe connectors.
4. Safety valves.
5. Pressure regulators. Include rated capacities and operating characteristics.
6. Automatic drain valves.
7. Filters. Include rated capacities and operating characteristics.
8. Lubricators. Include rated capacities and operating characteristics.
9. Quick couplings.
10. Hose assemblies.

1.6 INFORMATIONAL SUBMITTALS

A. Brazing and welding certificates.

B. Qualification Data: For Installers.

C. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Extruded-Tee Outlet Procedure: Qualify operators according to training provided by T-DRILL Industries Inc., for making branch outlets.
2. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.
3. Pressure-Seal Joining Procedure for Steel Piping. Qualify operators according to training provided by Victaulic Company.

B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

D. ASME Compliance:

1. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
2. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of compressed-air service.
2. Do not proceed with interruption of compressed-air service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.

1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.
5. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.
6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.
7. Grooved-End Fittings and Couplings:

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) Anvil International, Inc.
2) Star Pipe Products; Star Fittings Div.
3) Victaulic Company.
4) Ward Manufacturing, Inc.

b. Grooved-End Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron casting; with grooves according to AWWA C606 and dimensions matching steel pipe.
c. Couplings: AWWA C606 or UL 213, for steel-pipe dimensions and rated for 300-psig minimum working pressure. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gaskets for oil-free compressed air. Provide NBR gaskets if compressed air contains oil or oil vapor.

B. Schedule 5, Steel Pipe: ASTM A 135, carbon steel with plain ends and zinc-plated finish.

1. Pressure-Seal Fittings: Listed and labeled by a qualified testing agency and FMG-approved, carbon-steel, pressure-seal housing with O-ring end seals suitable for compressed-air piping and rated for 300-psig minimum working pressure. Provide EDPM seals for oil-free compressed air. Provide NBR seals if compressed air contains oil or oil vapor.

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) Victaulic Company.

C. Copper Tube: ASTM B 88, Type K or L seamless, drawn-temper, water tube.

1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
3. Copper Unions: ASME B16.22 or MSS SP-123.

4. Grooved-End Fittings and Couplings:

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) Anvil International, Inc.
2) Victaulic Company.

b. Grooved-End Fittings: ASTM B 75, copper tube or ASTM B 584, bronze castings.
c. Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for compressed air, and bolts

and nuts. Provide EDPM gasket for oil-free compressed air. Provide NBR gasket if compressed air contains oil or oil vapor.

D. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

E. Aluminum Pipe/Tube and fittings for Compressed Air: ASME B31.1, B31.2

1. Pipe/Tubing - MATERIAL: Extruded aluminum EN AW 6060 T6 UNI-EN 573-3 alloy; TREATMENT: internal-external titanium (compliance with RoSH et REACH); COATING: Electrostatic paint
2. Fittings - aluminum w/SS compression ring, dual lobe nitrile seal (viton if required)
3. System to be ISO 9001, CE, PED, CRN, and ASME B31.1/3 pressure rated, EN 13501-1, UL 723 Fire classification, ATEX 2014/34/EU rated
4. Fluid quality rating - ISO 8753-1 Class 0.0.0
5. Oil Free, Silicone Free, UV resistant system (pipe 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:

        1) Prevost Incorporated

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for compressed-air 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.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

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.

2.3 VALVES

A. Metal Ball, Butterfly, Check, Gate, and Globe Valves: Comply with requirements in Section 220523 "General-Duty Valves for Plumbing Piping."

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

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. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Hart Industries International, Inc.
   d. Jomar International Ltd.
   e. Matco-Norca, Inc.
   f. McDonald, A. Y. Mfg. Co.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   h. Wilkins; a Zurn company.

2. Description:

   a. Standard: ASSE 1079.
   b. Pressure Rating: 125 psig minimum at 180 deg F.
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

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. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Matco-Norca, Inc.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   e. Wilkins; a Zurn company.

2. Description:

   a. Standard: ASSE 1079.
   b. Factory-fabricated, bolted, companion-flange assembly.
   c. Pressure Rating: 125 psig minimum at 180 deg F.
   d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

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. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company.
    d. Pipeline Seal and Insulator, Inc.

2. 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.

2.5 FLEXIBLE PIPE CONNECTORS

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. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Hyspan Precision Products, Inc.
4. Mercer Rubber Co.
5. Metraflex, Inc.
6. Proco Products, Inc.
7. Unaflex, Inc.
8. Universal Metal Hose; a Hyspan Company

B. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: 250 psig minimum.
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.

C. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: 250 psig minimum.
2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
3. End Connections, NPS 2-1/2 and Larger: Flanged steel nipple.

2.6 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.

1. Type: Pilot operated.

C. Air-Line Pressure Regulators: Diaphragm operated, aluminum alloy or plastic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

D. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated.

E. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated.

F. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock. Include mounting bracket if wall mounting is indicated.

G. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Include mounting bracket if wall mounting is indicated.

1. Provide with automatic feed device for supplying oil to lubricator.

2.7 QUICK COUPLINGS

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. Prevost Corporation

2. Aeroquip Corporation; Eaton Corp.
3. Bowes Manufacturing Inc.

4. Foster Manufacturing, Inc.
5. Milton Industries, Inc.
6. Parker Hannifin Corp.; Fluid Connectors Group; Quick Coupling Div.
7. Rectus Corp.
8. Schrader-Bridgeport; Amflo Div.Schrader-Bridgeport/Standard Thomson.
9. Snap-Tite, Inc.; Quick Disconnect & Valve Division.
10. TOMCO Products Inc.
11. Tuthill Corporation; Hansen Coupling Div.

B. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

C. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
2. Plug End: Flow-sensor-bleeder, check-valve type with barbed outlet for attaching hose.

D. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
2. Plug End: With barbed outlet for attaching hose.

2.8 HOSE ASSEMBLIES

A. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.

1. Hose: Reinforced single- or double-wire-braid, CR-covered hose for compressed-air service.
2. Hose Clamps: Stainless-steel clamps or bands.
3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Compressed-Air Piping between Air Compressors and Receivers: Use one of the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, black or galvanized-steel pipe; threaded, malleable-iron fittings; and threaded joints.
2. NPS 2 and Smaller: Schedule 5, galvanized-steel pipe; pressure-seal fittings; and pressure-sealed joints.
3. NPS 2 and Smaller: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
4. NPS 2 and Smaller: Type K or L, copper tube; wrought-copper fittings; and brazed joints.

B. Low-Pressure Compressed-Air Distribution Piping: Use[one of] the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, [black] [galvanized]-steel pipe; threaded, malleable-iron fittings; and threaded joints.
2. NPS 2 and Smaller: Schedule 5, galvanized-steel pipe; pressure-seal fittings; and pressure-sealed joints.
3. NPS 2 and Smaller: Type K or L, copper tube; wrought-copper fittings; and brazed[or soldered] joints.
4. NPS 2 and Smaller: Type K or L, copper tube; press-type fittings; and pressure-sealed joints.
5. NPS 2 and Smaller: 63-mm and smaller, blue ABS pipe and fittings; transition fittings; valves; and solvent-cemented joints.
6. NPS 2 and Smaller: Green ABS pipe and fittings, transition fittings, and valves; and solvent-cemented joints.
7. NPS 2 and Smaller: HDPE pipe, fittings, and valves; and heat-fusion joints.
8. Retain "one of" option in paragraph below to allow Contractor to select piping materials from those retained.

C. High-Pressure Compressed-Air Distribution Piping: Use[one of] the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, [black] [galvanized]-steel pipe; threaded, malleable-iron fittings; and threaded joints.
2. NPS 2 and Smaller: Schedule 5, galvanized-steel pipe; pressure-seal fittings; and pressure-sealed joints.
3. NPS 2 and Smaller: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
4. NPS 2 and Smaller: Type K or L, copper tube; wrought-copper fittings; and brazed or soldered joints.

5. Retain "one of" option in paragraph below to allow Contractor to select piping materials from those retained.

D. Drain Piping: Use one of the following piping materials:

1. NPS 2 and Smaller: Type M copper tube; wrought-copper fittings; and brazed or soldered joints.
2. NPS 2 and Smaller: PVC pipe and fittings; and solvent-cemented joints.

3.2 VALVE APPLICATIONS

A. General-Duty Valves: Comply with requirements in Section 220523 "General-Duty Valves for Plumbing Piping" for metal general-duty valves. Use metal valves, unless otherwise indicated.

1. Metal General-Duty Valves: Use valve types specified in "Valve Applications" Article in Section 220523 "General-Duty Valves for Plumbing Piping" according to the following:

a. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
b. High-Pressure Compressed Air: Valve types specified for medium-pressure compressed air.
c. Equipment Isolation NPS 2 and Smaller: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.
d. Grooved-end valves may be used with grooved-end piping and grooved joints.

2. Plastic General-Duty Valves: Provide valves, made by piping manufacturer, that are compatible with piping. Do not use plastic valves between air compressors and receivers.

a. Blue ABS Piping System: Ball and butterfly valves.
b. Green ABS Piping System: Ball valves.
c. HDPE Piping System: Ball valves.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping concealed from view and protected from physical contact by building occupants, 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 otherwise indicated.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.

E. Install piping adjacent to equipment and machines to allow service and maintenance.

F. Install air and drain piping with 1 percent slope downward in direction of flow.

G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.

H. Equipment and Specialty Flanged Connections:

1. Use steel companion flange with gasket for connection to steel pipe.
2. Use cast-copper-alloy companion flange with gasket and brazed[or soldered] joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.

I. Flanged joints may be used instead of specified joint for any piping or tubing system.

J. Extended-tee outlets with brazed branch connection may be used for copper tubing, within extruded-tee connection diameter to run tube diameter ratio for tube type, according to Extruded Tee Connections Sizes and Wall Thickness for Copper Tube (Inches) Table in ASTM F 2014.

K. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

L. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

M. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."

N. Install piping to permit valve servicing.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install seismic restraints on piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 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. 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.

D. Welded Joints for Steel Piping: Join according to AWS D10.12/D10.12M.

E. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B 828 or CDA's "Copper Tube Handbook."

G. Extruded-Tee Outlets for Copper Tubing: Form branches according to ASTM F 2014, with tools recommended by procedure manufacturer, and using operators qualified according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

I. Grooved Joints: Assemble couplings with housing, gasket, lubricant, and bolts. Join according to AWWA C606 for grooved joints. Do not apply lubricant to prelubricated gaskets.

J. Heat-Fusion Joints for PE Piping: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 for socket-fusion joints.

K. Pressure-Sealed Joints: Join with tools recommended by fitting manufacturer, using operators qualified according to Part 1 "Quality Assurance" Article.

L. Solvent-Cemented Joints for ABS Piping: Clean and dry joining surfaces. Join according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. Join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2235 Appendix.

M. Solvent-Cemented Joints for PVC Piping: Clean and dry joining surfaces. Join according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. Apply primer and join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2672.

N. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.5 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Section 220523 "General-Duty Valves for Plumbing Piping."

B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.

C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.

D. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. NPS 2 and Smaller: Use dielectric unions.

C. NPS 2-1/2 to NPS 4: Use dielectric flanges.

D. NPS 5 and Larger: Use dielectric flange kits.

3.7 FLEXIBLE PIPE CONNECTOR INSTALLATION

A. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.

B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.

C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

3.8 SPECIALTY INSTALLATION

A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.

B. Install air-main pressure regulators in compressed-air piping at or near air compressors.

C. Install air-line pressure regulators in branch piping to equipment and tools.

D. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor drain.

E. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters. Mount on wall at locations indicated.

F. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters. Mount on wall at locations indicated.

G. Install air-line lubricators in branch piping to machine tools. Mount on wall at locations indicated.

H. Install quick couplings at piping terminals for hose connections.

I. Install hose assemblies at hose connections.

3.9 CONNECTIONS

A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

B. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment and machine.

3.10 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

C. Vertical Piping: MSS Type 8 or 42, clamps.

D. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

F. Base of Vertical Piping: MSS Type 52, spring hangers.

G. Support horizontal piping within 12 inches of each fitting and coupling.

H. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

I. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 to NPS 1/2: 96 inches with 3/8-inch rod.
2. NPS 3/4 to NPS 1-1/4: 84 inches with 3/8-inch rod.
3. NPS 1-1/2: 12 feet with 3/8-inch rod.
4. NPS 2: 13 feet with 3/8-inch rod.
5. NPS 2-1/2: 14 feet with 1/2-inch rod.
6. NPS 3: 15 feet with 1/2-inch rod.
7. NPS 3-1/2: 16 feet with 1/2-inch rod.
8. NPS 4: 17 feet with 5/8-inch rod.
9. NPS 5: 19 feet with 5/8-inch rod.
10. NPS 6: 21 feet with 3/4-inch rod.
11. NPS 8: 24 feet with 3/4-inch rod.
12. NPS 10: 26 feet with 7/8-inch rod.
13. NPS 12: 30 feet with 7/8-inch rod.

J. Install supports for vertical, Schedule 40, steel piping every 15 feet.

K. Install hangers for Schedule 5, steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/2: 72 inches with 3/8-inch rod.
2. NPS 3/4: 84 inches with 3/8-inch rod.
3. NPS 1: 96 inches with 3/8-inch rod.
4. NPS 1-1/4: 108 inches with 3/8-inch rod.
5. NPS 1-1/2: 10 feet with 3/8-inch rod.
6. NPS 2: 11 feet with 3/8-inch rod.

L. Install supports for vertical, Schedule 5, steel piping every 10 feet.

M. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4: 60 inches with 3/8-inch rod.
2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
3. NPS 3/4: 84 inches with 3/8-inch rod.
4. NPS 1: 96 inches with 3/8-inch rod.
5. NPS 1-1/4: 108 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.
7. NPS 2: 11 feet with 3/8-inch rod.
8. NPS 2-1/2: 13 feet with 1/2-inch rod.
9. NPS 3: 14 feet with 1/2-inch rod.
10. NPS 3-1/2: 15 feet with 1/2-inch rod.
11. NPS 4: 16 feet with 1/2-inch rod.
12. NPS 5: 18 feet with 1/2-inch rod.
13. NPS 6: 20 feet with 5/8-inch rod.
14. NPS 8: 23 feet with 3/4-inch rod.

N. Install supports for vertical copper tubing every 10 feet.

O. Install vinyl-coated hangers for ABS piping with the following maximum horizontal spacing and minimum rod diameters:

1. All Sizes: Install continuous support for piping with compressed air at normal operating temperature above [100 deg F] <Insert temperature>.
2. NPS 3/8 and NPS 1/2: 30 inches with 3/8-inch rod.
3. NPS 3/4: 38 inches with 3/8-inch rod.
4. NPS 1: 40 inches with 3/8-inch rod.
5. NPS 1-1/4: 45 inches with 3/8-inch rod.
6. NPS 1-1/2: 52 inches with 3/8-inch rod.
7. NPS 2: 58 inches with 3/8-inch rod.
8. NPS 3: 68 inches with 1/2-inch rod.
9. NPS 4: 76 inches with 1/2-inch rod.

P. Install supports for vertical ABS piping every 48 inches.

Q. Install vinyl-coated hangers for HDPE piping with the following maximum horizontal spacing and minimum rod diameters:

1. All Sizes: Install continuous support for piping with compressed air at normal operating temperature above 100 deg F.
2. NPS 1/2: 30 inches with 3/8-inch rod.
3. NPS 3/4: 35 inches with 3/8-inch rod.
4. NPS 1: 40 inches with 3/8-inch rod.
5. NPS 1-1/4: 43 inches with 3/8-inch rod.
6. NPS 1-1/2: 49 inches with 3/8-inch rod.
7. NPS 2: 55 inches with 3/8-inch rod.
8. NPS 3 and NPS 4: 96 inches with 1/2-inch rod.

R. Install supports for vertical HDPE piping every 48 inches.

3.11 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

3.12 FIELD QUALITY CONTROL

A. Perform field tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Piping Leak Tests for ABS Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen, at temperature of 110 deg F or less, to pressure of 40 psig above system operating pressure, but not less than 80 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
3. Piping Leak Tests for HDPE Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen, at temperature of 100 deg F or less, to pressure of 40 psig above system operating pressure, but not less than 100 psig or more than 180 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
4. Repair leaks and retest until no leaks exist.

5. Inspect filters, lubricators and pressure regulators for proper operation.

C. Prepare test reports.

END OF SECTION 221513

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Commercial, light-duty, storage, electric, domestic-water heaters.
2. Flow-control, electric, tankless, domestic-water heaters.
3. Domestic-water heater accessories.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 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 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For commercial domestic-water heaters, 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.

B. Product Certificates: For each type of commercial, electric, domestic-water heater, from manufacturer.

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Source quality-control reports.

E. Field quality-control reports.

F. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.7 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/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. 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."

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including storage tank and supports.
    b. Faulty operation of controls.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

    a. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:

        1) Storage Tank: Five years.
        2) Controls and Other Components: Two years.

    b. Electric, Tankless, Domestic-Water Heaters: Five years.
    c. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, domestic-WATER HEATERS

A. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. American Water Heaters.
    b. Bradford White Corporation.
    c. Electric Heater Company (The).
    d. GSW Water Heating.
    e. Heat Transfer Products, Inc.
    f. Lochinvar Corporation.
    g. Rheem Manufacturing Company.
    h. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
    i. State Industries.

2. Standard: UL 174.
3. Storage-Tank Construction: Steel, vertical arrangement.

    a. Tappings: ASME B1.20.1 pipe thread.
    b. Pressure Rating: 150 psig (1035 kPa).
    c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

4. Factory-Installed Storage-Tank Appurtenances:

    a. Anode Rod: Replaceable magnesium.
    b. Dip Tube: Required unless cold-water inlet is near bottom of tank.

c. Drain Valve: ASSE 1005.
d. Insulation: Comply with ASHRAE/IESNA 90.1[or ASHRAE 90.2].
e. Jacket: Steel with enameled finish.
f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation unless otherwise indicated. Limited to 12 kW total.
h. Temperature Control: Adjustable thermostat.
i. Safety Control: High-temperature-limit cutoff device or system.
j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

5. Special Requirements: NSF 5 construction with legs for off-floor installation.

2.2 ELECTRIC, TANKLESS, domestic-WATER HEATERS

A. Flow-Control, Electric, Tankless, Domestic-Water Heaters:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Bosch Water Heating.
b. Chronomite Laboratories, Inc.
c. Eemax, Inc.
d. Stiebel Eltron, Inc.

2. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.
3. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.

a. Connections: ASME B1.20.1 pipe thread.
b. Pressure Rating: [150 psig (1035 kPa)] <Insert value>.
c. Heating Element: Resistance heating system.
d. Temperature Control: Flow-control fitting.
e. Safety Control: High-temperature-limit cutoff device or system.
f. Jacket: Aluminum or steel with enameled finish or plastic.

4. Support: Bracket for wall mounting.

2.3 domestic-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

    a. AMTROL Inc.
    b. Flexcon Industries.
    c. Honeywell International Inc.
    d. Pentair Pump Group (The); Myers.
    e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
    f. State Industries.
    g. Taco, Inc.
    h. <Insert manufacturer's name>.

3. 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.
4. 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.

5. Capacity and Characteristics:

    a. Working-Pressure Rating: 150 psig (1035 kPa).
    b. Capacity Acceptable: 2 gal. (7.6 L) minimum.
    c. Air Precharge Pressure: 80psi.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 (DN 20) with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1[or ASHRAE 90.2].

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- (172.5-kPa-) maximum outlet pressure unless otherwise indicated.

F. 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 domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

G. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

I. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

J. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches (457 mm) above the floor.

K. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test[commercial] domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in [Section 033000 "Cast-in-Place Concrete."] [Section 033053 "Miscellaneous Cast-in-Place Concrete."]

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

B. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters[at least 18 inches (457 mm) above floor] on wall bracket.

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
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 domestic-water heaters to substrate.

C. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

D. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

E. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install [combination temperature-and-]pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

G. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

H. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

I. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

J. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

K. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of [25 psig (172 kPa)] <Insert value>. Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 221119 "Domestic Water Piping Specialties."

L. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

M. Fill electric, domestic-water heaters with water.

N. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "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. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "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] [Train] Owner's maintenance personnel to adjust, operate, and maintain [commercial] [and] [tankless], electric, domestic-water heaters.

END OF SECTION 223300

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

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. Water closets.
2. Flushometer valves.
3. Toilet seats.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves[**and electronic sensors**] to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 WALL-MOUNTED WATER CLOSETS

A. Water Closets: Wall mounted, top spud.

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

a. American Standard America.

2. Bowl:

    a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
    b. Material: Vitreous china.
    c. Type: Siphon jet.
    d. Style: Flushometer valve.
    e. Rim Contour: Elongated.
    f. Water Consumption: 1.28 gal. per flush.
    g. Spud Size and Location: NPS 1-1/2; top.
3. Support:

    a. Standard: ASME A112.6.1M.
    b. Description: Waste-fitting assembly as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.
    c. Water-Closet Mounting Height: As indicated on the drawings

2.2 FLUSHOMETER VALVES

A. Solenoid-Actuator, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    a. Sloan Valve Company.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
10. Trip Mechanism: Hard-wired electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
11. Consumption: 1.28 gal. per flush.
12. Minimum Inlet: NPS 1.
13. Minimum Outlet: NPS 1-1/2.

2.3 TOILET SEATS

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

a. Church Seats.

2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

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 water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.

2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224216.13 - COMMERCIAL LAVATORIES

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. Faucets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

      a. Servicing and adjustments of automatic faucets.

PART 2 - PRODUCTS

2.1 SOLID-BRASS, AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets Automatic-type, hard-wired**,** electronic-sensor-operated, nonmixing, solid-brass valve.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Chicago Faucets.

2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
3. 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.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
5. Body Type: Single hole.
6. Body Material: Commercial, solid brass.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 0.5 gpm.
9. Mounting Type: Deck, concealed.
10. Spout: Rigid type.
11. Spout Outlet: Spray.
12. Drain: Not part of faucet.

2.2 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Wheel handle.

F. Risers:

1. NPS 3/8.
2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2.3 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/4.
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 17 ga. brass tube to wall; and chrome-plated, brass or steel wall flange.

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 lavatory installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

B. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

C. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16 - COMMERCIAL SINKS

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. Utility sinks.
2. Sink faucets.
3. Supply fittings.
4. Waste fittings.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential sinks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials 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.

PART 2 - PRODUCTS

2.1 UTILITY SINKS

A. Utility Sinks US-1: Enameled, cast iron, trap standard mounted.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.
b. Commercial Enameling Company.
c. Gerber Plumbing Fixtures LLC.
d. Kohler Co.
e. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Fixture:

a. Standard: ASME A112.19.1/CSA B45.2.
b. Type: Service sink with back.
c. Back: Two faucet hole.
d. Nominal Size: 24 by 20 inches (610 by 508 mm).
e. Color: White.
f. Mounting: NPS 3 (DN 80) P-trap standard with grid strainer inlet, cleanout, and floor flange.
g. Rim Guard: On front and sides.

3. Faucet: K-8907.
4. Support: ASME A112.6.1M, Type II, sink carrier.

2.2 SINK FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets Manual type, single-control, two-lever-handle mixing valve.

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. American Standard America.
    b. Bradley Corporation.
    c. Chicago Faucets.
    d. Delta Faucet Company.
    e. Elkay Manufacturing Co.
    f. GROHE America, Inc.
    g. Just Manufacturing.
    h. Kohler Co.
    i. Moen Incorporated.
    j. Speakman Company.
    k. T & S Brass and Bronze Works, Inc.
    l. Zurn Industries, LLC; Commercial Brass and Fixtures.
    m. American Standard America.
    n. Bradley Corporation.
    o. BrassTech Inc.
    p. Central Brass Company.
    q. Chicago Faucets.
    r. Danze, Inc.
    s. Delta Faucet Company.
    t. Eljer, Inc.
    u. Elkay Manufacturing Co.
    v. Franke Consumer Products, Inc.
    w. Gerber Plumbing Fixtures LLC.
    x. Griffin Products, Inc.
    y. GROHE America, Inc.
    z. Hansgrohe USA.
    aa. Hydrotek International, Inc.
    bb. Intersan Manufacturing Company.
    cc. Just Manufacturing.
    dd. Kohler Co.
    ee. Matco-Norca.
    ff. Moen Incorporated.
    gg. Price Pfister, Inc.
    hh. Speakman Company.
    ii. T & S Brass and Bronze Works, Inc.
    jj. WhiteRock Corp.
    kk. Wolverine Brass, Inc.
    ll. Zurn Industries, LLC; Commercial Brass and Fixtures.
    mm. American Standard America.
    nn. Briggs Plumbing Products, Inc.
    oo. Danze, Inc.
    pp. Delta Faucet Company.
    qq. Eljer, Inc.

rr. Ferguson Enterprises, Inc.; ProFlo Brand.
ss. Gerber Plumbing Fixtures LLC.
tt. Matco-Norca.
uu. Moen Incorporated.
vv. Sterling; a Kohler company.
ww. WhiteRock Corp.
xx. Wolverine Brass, Inc.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Type: Centerset.
5. Body Material: General-duty, solid brass.
6. Finish: Chrome plated.
7. Maximum Flow Rate: 2.2 gpm (8.3 L/min.).
8. Handle(s): Lever, Wrist blade, 4 inches (102 mm)].
9. Mounting Type: Deck, concealed.
10. Spout Type: Rigid, solid brass, Rigid, solid brass with wall brace.
11. Vacuum Breaker: Required for hose outlet.
12. Spout Outlet: Aerator, Hose thread according to ASME B1.20.7.

2.3 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:

1. NPS 3/8 (DN 10)
2. Chrome-plated, rigid-copper pipe.

2.4 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 (DN 40) offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2 (DN 40).
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall; and chrome-plated brass or steel wall flange.
3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless-steel tube to wall; and stainless-steel wall flange.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

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 sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 224223 - COMMERCIAL SHOWERS, RECEPTORS, AND BASINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Individual shower receptors.
2. Shower faucets.
3. Grout.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for showers.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For shower faucets to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 INDIVIDUAL SHOWERS

A. Individual PMMA Showers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Aquatic Industries, Inc.

2. General: PMMA shower enclosure with faucet and receptor and appurtenances.

3. Standard: ANSI Z124.1.2.
4. Type: One-piece unit without top.
5. Style: As indicated on the drawings.
6. Color: White.
7. Bathing Surface: Slip resistant according to ASTM F 462.
8. Outlet: Drain with NPS 2 outlet.
9. Grab Bar: ASTM F 446, mounted on support area back wall on units indicated to be accessible on the drawings.

2.2 SHOWER FAUCETS

A. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for shower materials that will be in contact with potable water.

B. Shower Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
   a. Moen Incorporated.
   b. Symmons Industries Inc.

3. Description: Single-handle, pressure-balance mixing valve with hot- and cold-water indicators; check stops; and shower head.
4. Faucet:

   a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016.
   b. Body Material: Solid brass.
   c. Finish: Polished chrome plate.
   d. Maximum Flow Rate: 1.5 gpm unless otherwise indicated.
   e. Mounting: Concealed.
   f. Operation: Single-handle, push-pull or twist or rotate control.
   g. Antiscald Device: Integral with mixing valve.
   h. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.

5. Supply Connections: NPS 1/2.
6. Shower Head:

   a. Standard: ASME A112.18.1/CSA B125.1.
   b. Type: Integral with mounting flange.
   c. Shower Head Material: Metallic with chrome-plated finish.
   d. Spray Pattern: Adjustable.
   e. Integral Volume Control: Not required.

f. Shower-Arm, Flow-Control Fitting: 1.5 gpm.
g. ADA Accessores: Provide hand held shower head with 5' hose

2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

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 shower installation.

B. Examine walls and floors for suitable conditions where showers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble shower components according to manufacturers' written instructions.

B. Install showers level and plumb according to roughing-in drawings.

C. Install water-supply piping with stop on each supply to each shower faucet.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with shower. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

D. Install shower flow-control fittings with specified maximum flow rates in shower arms.

E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheons requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Seal joints between showers and floors and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with traps and soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust showers and controls. Replace damaged and malfunctioning showers, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of showers, inspect and repair damaged finishes.

B. Clean showers, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed fixtures and fittings.

D. Do not allow use of showers for temporary facilities unless approved in writing by Owner.

END OF SECTION 224223

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. Section Includes:
1. Combination units.
2. Supplemental equipment.
3. Water-tempering equipment.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.

D. Tepid: Moderately warm.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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

1. Flushing-Fluid Solution: Separate lot and equal to at least [200] <Insert number> percent of amount of solution installed for each self-contained unit.

1.8 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. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

D. Regulatory Requirements: Comply with requirements in ICC/ANSI 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.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS

A. Accessible, Plumbed Emergency Shower with Eye/Face Wash Combination Units, ES-1
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Acorn Safety; a division of Acorn Engineering Company.
b. Bradley Corporation.
c. Encon Safety Products.
d. Guardian Equipment Co.
e. Haws Corporation.
f. Sellstrom Manufacturing Company.
g. Speakman Company.
h. WaterSaver Faucet Co.

2. Piping:

a. Material: PVC.
b. Unit Supply: [NPS 1-1/4 (DN 32) minimum] [NPS 1-1/2 (DN 40)].
c. Unit Drain: Outlet at back or side near bottom.

3. Shower:

a. Capacity: Not less than 20 gpm (76 L/min.) for at least 15 minutes.

b. Supply Piping: NPS 1 (DN 25) with flow regulator and stay-open control valve.
c. Control-Valve Actuator: Pull rod.
d. Shower Head: 8-inch- (200-mm-) minimum diameter, chrome-plated brass or stainless steel.
e. Mounting: Pedestal.

4. Eye/Face Wash Unit:

a. Capacity: Not less than 3 gpm (11.4 L/min.) for at least 15 minutes.
b. Supply Piping: NPS 1/2 (DN 15) with flow regulator and stay-open control valve.
c. Control-Valve Actuator: Paddle.
d. Spray-Head Assembly: Two or four receptor-mounted spray heads.
e. Receptor: Chrome-plated brass or stainless-steel bowl.
f. Mounting: Attached to shower pedestal.
g. Drench-Hose Option: May be provided instead of eye/face wash unit.

1) Capacity: Not less than 3 gpm (11.4 L/min.) for at least 15 minutes.
2) Drench Hose: Hand-held spray head with squeeze-handle actuator and hose.
3) Mounting: Bracket on shower pedestal.

2.2 SUPPLEMENTAL EQUIPMENT

2.3 WATER-TEMPERING EQUIPMENT

A. Hot- and Cold-Water, Water-Tempering Equipment, :
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Acorn Safety; a division of Acorn Engineering Company.
b. Armstrong International, Inc.
c. Bradley Corporation.
d. Encon Safety Products.
e. Guardian Equipment Co.
f. Haws Corporation.
g. Lawler Manufacturing Co., Inc.
h. Leonard Valve Company.
i. Powers; a division of Watts Water Technologies, Inc.
j. Speakman Company.
k. <Insert manufacturer's name>.

2. Description: Factory-fabricated equipment with thermostatic mixing valve.

a. Thermostatic Mixing Valve: Designed to provide 85 deg F (29 deg C) tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F (3 deg C)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.
b. Supply Connections: For hot and cold water.

2.4 SOURCE QUALITY CONTROL

A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

B. 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. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 221116 "Domestic Water Piping."

F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

G. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."

H. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."

I. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

J. Fill self-contained fixtures with flushing fluid.

3.3 CONNECTIONS

A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment. Comply with requirements for cold-water piping specified in Section 221116 "Domestic Water Piping."

B. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Section 221116 "Domestic Water Piping."

C. Connect cold water and electrical power to electric heating water-tempering equipment. Comply with requirements for cold-water piping specified in Section 221116 "Domestic Water Piping."

D. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary waste and vent piping. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."

E. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.

F. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection.
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 unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures[and water-tempering equipment] will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 224500

SECTION 230513 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes basic requirements for factory and field-installed installed motors.

B. See Division 23 Section "Mechanical Vibration and Seismic Controls" for mounting motors and vibration isolation and seismic-control devices.

C. See individual Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.2 SUBMITTALS

A. Product Data for Field-Installed Motors: For each type and size of motor, provide nameplate data and ratings; shipping, installed, and operating weights; enclosure type and mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.

B. Shop Drawings for Field-Installed Motors: Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:

1. Each installed unit's type and details.
2. Nameplate legends.
3. Diagrams of power, signal, and control wiring. Provide schematic wiring diagram for each type of motor and for each control scheme.

C. Qualification Data: For testing agency.

D. Field quality-control test reports.

E. Operation and Maintenance Data.

1.3 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.

1.4 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:

1. Compatible with the following:

a. Magnetic controllers.
b. Multispeed controllers.
c. Reduced-voltage controllers.
d. Motor Control Centers.

2. Motors for use with variable frequency drives shall meet all requirements of drive manufacturer, and shall be suitable for use throughout speed range without overheating.
3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

A. Motor requirements apply to factory and field-installed installed motors except as follows:

1. Different ratings, performance, or characteristics for motor are specified in another Section.
2. Motorized-equipment manufacturer requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

B. Motors shall be as manufactured by Century, Baldor, Marathon, General Electric or Westinghouse. Motors provided with packaged equipment shall be of motor manufacturer as selected by equipment manufacturer.

C. All motors furnished shall be Energy Efficient Electric Motors. The minimum nominal full-load efficiency for motors shall comply with Table C403.2.11.1 of the latest edition of the Washington State Energy Code.

2.2 MOTOR CHARACTERISTICS

A. Motors 3/4 HP and Larger: Three phase.

B. Motors Smaller Than 3/4 HP: Single phase.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

E. Service Factor: Unless otherwise noted, single phase motors shall be capacitor-start type with service factor of 1.25 or higher. Three phase motors shall have a service factor of 1.15 or higher.

F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

G. 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.

H. Enclosure: Open drip proof.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium, as defined in NEMA MG 1.

C. Stator: Copper windings, unless otherwise indicated.

1. Multispeed motors shall have separate winding for each speed.

D. Rotor: Squirrel cage, unless otherwise indicated.

E. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating, unless otherwise indicated.

G. Insulation: Class F, unless otherwise indicated.

H. 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.

I. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Inrush 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. Designed with critical vibration frequencies outside operating range of controller output.
2. Temperature Rise: Matched to rating for Class B insulation.
3. Insulation: Class H.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Rugged-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with non-hygroscopic material.

1. Finish: Chemical-resistant paint over corrosion-resistant primer.

D. Source Quality Control for Field-Installed Motors: Perform the following tests on each motor according to NEMA MG 1:

1. Measure winding resistance.
2. Read no-load current and speed at rated voltage and frequency.
3. Measure locked rotor current at rated frequency.
4. Perform high-potential test.

2.5 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. 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.

D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

E. Source Quality Control for Field-Installed Motors: Perform the following tests on each motor according to NEMA MG 1:

1. Measure winding resistance.
2. Read no-load current and speed at rated voltage and frequency.
3. Measure locked rotor current at rated frequency.

4. Perform high-potential test.

PART 3 - EXECUTION

3.1 FIELD-INSTALLED MOTOR INSTALLATION

A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align with load transfer link.

B. Comply with mounting and anchoring requirements specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

3.2 FIELD QUALITY CONTROL FOR FIELD-INSTALLED MOTORS

A. Prepare for acceptance tests.

1. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer's written instructions.
2. Verify bearing lubrication.
3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
4. Test interlocks and control and safety features for proper operation.
5. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical tests and visual and mechanical inspections including optional tests and inspections stated in NETA ATS on factory and field-installed installed motors. 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.

END OF SECTION 23 05 13

SECTION 230518 - ESCUTCHEONS 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. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass **or** split-casting brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type **or** split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

2. Escutcheons for Existing Piping:

a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated finish.
f. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Support information in this section is for steel pipe only. See spec section

B. This Section includes the following:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Equipment supports.

C. See Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

D. See Division 23 Section "Mechanical Vibration and Seismic Controls" for vibration isolation devices.

1.2 DEFINITIONS

A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes 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.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.

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. Equipment supports.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

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. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.
3. Globe Pipe Hanger Products, Inc.
4. Grinnell Corp.
5. National Pipe Hanger Corporation.
6. PHD Manufacturing, Inc.
7. PHS Industries, Inc.
8. Piping Technology & Products, Inc.
9. Tolco Inc.

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. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. 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. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, 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. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:
    a. Hilti, Inc.
    b. ITW Ramset/Red Head.
    c. Masterset Fastening Systems, Inc.
    d. MKT Fastening, LLC.
    e. Powers Fasteners.

B. 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. Manufacturers:
    a. B-Line Systems, Inc.; a division of Cooper Industries.
    b. Empire Industries, Inc.
    c. Hilti, Inc.
    d. ITW Ramset/Red Head.
    e. MKT Fastening, LLC.
    f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 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. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 .
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. 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.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. 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.

H. 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.

I. 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. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. 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:
8. Light (MSS Type 31): 750 lb.
9. Medium (MSS Type 32): 1500 lb.
10. Heavy (MSS Type 33): 3000 lb.
11. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
12. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

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 powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. 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 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.

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 B31.1 (for power piping) and 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. Hydronic Piping: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    b. 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.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
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.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. 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.

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. 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 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 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. 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.

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. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. 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. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. 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 incheshigh.

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 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.

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.

B. Pipe Label Color Schedule:
   1. Refrigerant Piping:
      a. Background Color: Yellow.
      b. Letter Color: Black.
   2. Natural Gas Piping:
      a. Background Color: Yellow.
      b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-

watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Refrigerant: 1-1/2 inches, round.

b. Natural Gas: 1-1/2 inches, round.

2. Valve-Tag Color:

a. Refrigerant: Natural.

b. Natural Gas: Natural.

3. Letter Color:

a. Refrigerant: Black.

b. Natural Gas: Black.

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 SUMMARY

A. This Section includes TAB to produce design objectives for the following:

1. Air Systems:

a. Constant-volume air systems.

2. HVAC equipment quantitative-performance settings.
3. Verifying that automatic control devices are functioning properly.
4. Reporting results of activities and procedures specified in this Section.

1.2 SUBMITTALS

A. 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.

B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

C. Warranties specified in this Section.

1.3 QUALITY ASSURANCE

A. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.

B. The air distribution systems and/or hydronic systems shall be balanced by a Balancing or Engineering Firm approved by the mechanical engineer prior to bid. The Balancing firm shall furnish the necessary instruments for making tests, perform balancing work, and issue a certified report of all balancing work performed. Balancing reports shall be AABC, NEBB certified or shall be certified by a registered professional mechanical engineer registered in the state where the project is located. The Mechanical Contractor shall include in his contract all costs including the Balancing Firm's charges. Pre-approved balancing firms include:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports

2. Energy Control, Inc

3. Testcom

4. Riley Engineering, Inc.

1.4 Precision Air Balance.

A. 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.

1.5 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. 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.

1.6 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. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes 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.

B. 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. 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, such as variable-air-volume boxes, 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 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.

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. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. 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.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. 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 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.

3.7 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.8 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. Electric-Heating Coils: Measure the following data for each coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. 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.

3.9 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.

3.10 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. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

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.

3.11 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.

3.12 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.

3.13 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 SUMMARY

A. This Section includes mechanical insulation for boiler breeching, duct, equipment, and pipe, including the following:

1. Insulation Materials:

    a. Glass fiber.
    b. Mineral fiber.

2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied jackets.
10. Tapes.
11. Securements.
12. Corner angles.

1.2 SUBMITTALS

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

B. Shop Drawings: Show details for the following:

1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Attachment and covering of heat tracing inside insulation.
3. Insulation application at pipe expansion joints for each type of insulation.
4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Removable insulation at piping specialties, equipment connections, and access panels.
6. Application of field-applied jackets.
7. Application at linkages of control devices.
8. Field application for each equipment type.

C. Field quality-control inspection reports.

1.3 QUALITY ASSURANCE

A. Mechanical insulation R values shall meet this specification, Washington State Energy Code, and/or ASHRAE/IESNA 90.1 whichever is the most stringent.

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, 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.

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.

2.2 INSULATION MATERIALS

A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. 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 Part 2 "Factory-Applied Jackets" Article.

1. Products:

a. CertainTeed Corp.; Duct Wrap.
b. Johns Manville; Microlite.

c. Knauf Insulation; Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; All-Service Duct Wrap.

2.3 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products:

a. Insulco, Division of MFS, Inc.; SmoothKote.
b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
c. Rock Wool Manufacturing Company; Delta One Shot.

2.4 INDOOR USE ADHESIVES

A. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates: Comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products:

    a. Childers Products, Division of ITW; CP-10.
    b. Foster Products Corporation, H. B. Fuller Company; 35-00.
    c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
    d. Marathon Industries, Inc.; 550.
    e. Mon-Eco Industries, Inc.; 55-50.
    f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F (Minus 29 to plus 93 deg C).
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.6 INDOOR SEALANTS

A. Joint Sealants:

1. For indoor applications, 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).

2.7 Color: White. SEALANTS

A. Joint Sealants:

1. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:

2. For indoor applications, 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).

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

1. Products:

    a. Childers Products, Division of ITW; Metal Jacketing Systems.
    b. PABCO Metals Corporation; Surefit.
    c. RPR Products, Inc.; Insul-Mate.

2. Sheet and roll stock ready for shop or field sizing.

3. Finish and thickness are indicated in field-applied jacket schedules.
4. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
5. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
6. Factory-Fabricated Fitting Covers:

    a. Same material, finish, and thickness as jacket.
    b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    c. Tee covers.
    d. Flange and union covers.
    e. End caps.
    f. Beveled collars.
    g. Valve covers.
    h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Width: 3 inches.
2. Film Thickness: 4 mils.
3. Adhesive Thickness: 1.5 mils.
4. Elongation at Break: 145 percent.
5. Tensile Strength: 55 lbf/inch in width.

2.10 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal.

B. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

1. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
2. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
3. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

C. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

1. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
2. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
3. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

D. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

1. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

2. Spindle: Copper or zinc-coated, low carbon steel, Aluminum, Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
3. Adhesive-backed base with a peel-off protective cover.

E. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

F. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

G. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

H. Wire: 0.062-inch soft-annealed, stainless steel.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 COMMON 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 with tightly butted joints free of voids and gaps. Vapor barriers shall be continuous. Before installing jacket material, install vapor-barrier system.

C. 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.

D. 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.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

H. Keep insulation materials dry during application and finishing.

I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

J. Install insulation with least number of joints practical.

K. Hangers and Anchors: 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.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. 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.

N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

P. 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.

Q. 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.

R. Ductwork with ductliner that has been allowed to become wet during the construction process will be removed from the site and replaced with new ductwork and liner

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
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.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. 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. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Through-Penetration Firestop Systems."

F. 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 according to Division 7 Section "Through-Penetration Firestop Systems."

3.4 DUCT AND PLENUM INSULATION INSTALLATION

A. 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 50 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.
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.

B. 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 50 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.
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.

3.5 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK 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-retarder mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

D. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.6 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket as specified in Division 9 painting Sections.

1. Apply two finish coats of interior, flat, latex-emulsion size over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Do not field paint aluminum jackets.

3.7 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Inspect ductwork, randomly selected by Owners Representative, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Owners Representative, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

3. Inspect pipe, fittings, strainers, and valves, randomly selected by Owners Representative, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements. Remove defective Work.

C. Install new insulation and jackets to replace insulation and jackets removed for inspection. Repeat inspection procedures after new materials are installed.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:
1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.9 DUCTWORK AND PLENUM INSULATION INSTALLATION

A. General Requirements:
1. For all rectangular and all round ducts, insulation shall be attached by applying adhesive around entire perimeter of the duct in 6” wide strips on 12” centers.
2. For rectangular ducts, 24” and larger insulation shall be additionally secured to bottom of ducts by use of mechanical fasteners. Fasteners shall be spaced on 18” centers and not more than 18” from duct corners.
3. Mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18” centers and not more than 18” from duct corners.
4. Insulation shall be impaled on the mechanical fasteners where used and shall be pressed thoroughly into the adhesive. Care shall be taken to overlap vapor barrier joints 2”. The in

sulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.

5. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back to the washer.
6. Jacket overlaps shall be secured under the overlap with adhesive and stapled on 4" centers.
7. Staples and seams shall be coated with vapor barrier coating.
8. Breaks in the jacket material shall be covered with patches of the same material as the vapor barrier. The patches shall extend not less than 2" beyond the break or penetration in all directions and shall be secured with adhesive and staples. Staples and joints shall be sealed with a brush coat of vapor barrier coating.
9. At jacket penetrations such as hangers, thermometers and damper operating rods, voids in the insulation shall be filled with vapor barrier coating and the penetration sealed with a brush coat of vapor barrier coating.
10. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.
11. Bands: Bands on 18" centers shall be provided on all insulation on concealed round duct.
12. Flexible Duct Insulation: Flexible ducts have been specified to have factory-applied insulation. This Contractor shall seal all connections with tape.

B. Outdoor Air Ductwork Insulation:

Duct System	**Duct Location and Use**	**Climate Zone**	**Airflow**	**Minimum Installed Duct Insulation R-value**
Outdoor Air	Inside conditioned space and upstream of automatic shutoff damper	4C and 5B	≥2800 CFM	R-16
Outdoor Air	Inside conditioned space and downstream of automatic shutoff damper of HVAC unit or room	4C	≥2800 CFM	R-8
Outdoor Air	Inside conditioned space and downstream of automatic shutoff damper to HVAC unit or room	5B	≥ 2800 CFM	R-12
Outdoor Air	Inside conditioned space	4C and 5B	< 2800 CFM	R-7

C. Supply, Return, Exhaust, and Relief Air Ductwork Insulation:

Duct System	Duct Location and Use	Climate Zone	Minimum Installed Duct Insulation R-value
Supply Air or Return Air	Outside the building (outdoors and exposed to weather)	4C	R-8
Supply Air or Return Air	Outside the building (outdoors and exposed to weather)	5B	R-12
Supply Air or Return Air	Unconditioned space (enclosed but not in the building conditioned envelope)	4C and 5B	R-6
Supply Air or Return Air	Unconditioned space where the duct conveys air that is within 15°F of the air temperature of the surrounding unconditioned space	4C and 5B	R-3.3
Supply Air or Return Air	Where located in a building envelope assembly	4C and 5B	R-16
Supply Air	Within conditioned space where the supply duct conveys air that is less than 55°F or greater than 105°F	4C and 5B	R-3.3
Supply Air	Within conditioned space that the duct directly serves where the supply duct conveys air that is less than 55°F or greater than 105°F	4C and 5B	None
Supply Air	Within conditioned space where the supply duct conveys air that is 55°F or greater and 105°F or less	4C and 5B	None
Return Air or Exhaust Air	Within conditioned space, downstream of an energy recovery media, upstream of an automatic shutoff damper	4C	R-8
Return Air or Exhaust Air	Within conditioned space, downstream of an energy	5B	R-12

	recovery media, upstream of an automatic shutoff damper		
Relief or Exhaust Air	Within conditioned space, and downstream of an automatic shutoff damper	4C and 5B	R-16

3.10 INDOOR, 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. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

D. None.

E. Ducts and Plenums, Exposed:
1. None.
2. PVC: 30 mils thick.
3. Aluminum, Smooth: 0.020 inch thick.
4. Painted Aluminum, Smooth: 0.020 inch thick.
5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish 0.016 inch thick.

3.11 OUTDOOR, 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. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:
1. None.

D. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
1. Aluminum, Smooth or Corrugated: 0.032 inch thick.
2. Painted Aluminum, Smooth or Corrugated: 0.024 inch thick.
3. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish or Corrugated: 0.020 inch thick.

E. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
   1. Aluminum, Smooth or Corrugated: 0.032 inch thick.
   2. Painted Aluminum, Smooth or Corrugated: 0.024 inch thick.
   3. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish or Corrugated: 0.020 inch thick.

END OF SECTION 230700

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. 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.

1.2 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. Supply Ducts: 2-inch wg.
b. Supply Ducts (Upstream from Air Terminal Units): 4-inch wg.
c. Supply Ducts (Downstream from Air Terminal Units): 2-inch wg.
d. Return Ducts (Negative Pressure): 2-inch wg.
e. Exhaust Ducts (Downstream of Fan): 2-inch wg.
f. Exhaust Ducts (Negative Pressure): 1-inch wg.

2. Sealant Class:

a. Supply Ducts : Class C.
b. Supply Ducts (Upstream from Air Terminal Units): Class A.
c. Supply Ducts (Downstream from Air Terminal Units): Class C.
d. Return Ducts (Negative Pressure): Class C.
e. Exhaust Ducts (Downstream of Fan): Class C.
f. Exhaust Ducts (Negative Pressure): Class C.

1.3 SUBMITTALS

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

B. Shop Drawings:

1. Factory- and shop-fabricated ducts and fittings.
2. Hangers and supports, including methods for duct and building attachment**,** and vibration isolation.

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

A. Duct sizes shown on drawings are outside nominal dimensions for sheet metal ductwork. Where ductwork is indicated on the drawings to be lined, an allowance for 1" or 2" thick insulation is included and duct sizes do not need to be increased to compensate for the insulation.

B. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

C. 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."

D. 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."

E. 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."

F. Rectangular to round branch duct connections shall use spin-in fittings: Spin-in fittings shall be DuroDyne or Air Control Products equal to Air Control Products Model S-SM-C with damper for unlined ductwork or Air Control Products Model S-DB-C with damper for lined ductgwork.

G. Rectangular to rectangular branch duct connections shall use 45 degree entry. Straight taps are not allowed.

H. Rectangular Elbows: All 90 degree rectangular elbows shall contain turning vanes. See section 15820 "Duct Accessories" for turning vane fabrication requirements.

2.2 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.

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. McGill AirFlow LLC.
b. SEMCO Incorporated.
c. Sheet Metal Connectors, Inc.
d. Spiral Manufacturing Co., Inc.

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."

1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.

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."

E. Round ducts and fittings: All round ductwork shall be spiral lock seams with spot welded sealed manufactured fittings, galvanized steel.

F. Round Elbows: All round elbows shall be pleated or segmented with a centerline radius of 1.5 times the cross section diameter.

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.

C. 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.

D. 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 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 45 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 (both PVC coated and bare), stainless steel, or aluminum sheets.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods: Cadmium-plated steel rods and nuts.

B. 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."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. 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.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

B. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections. Fittings shall be full bodied fittings on all new duct installations. Saddle fittings shall only be allowed on connections to existing duct work.

C. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

D. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

E. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

F. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

G. 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.

H. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 SEAM AND JOINT SEALING

A. Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.

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 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel:

B. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

C. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Velocity 1500 fpm or lower:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) 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.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

D. 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: Spin in.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1500 fpm or Lower: Conical tap.
b. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Turning vanes.
3. Duct-mounted access doors.
4. Flexible connectors.
5. Flexible ducts.
6. Duct accessory hardware.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Manual Volume dampers.
2. Flexible connectors.
3. Flexible ducts.

B. Operation and maintenance data.

1.3 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.

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. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish.

D. 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.

E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. 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 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. Flexmaster U.S.A., Inc.
    d. McGill AirFlow LLC.
    e. METALAIRE, Inc.
    f. Nailor Industries Inc.
    g. Pottorff; a division of PCI Industries, Inc.
    h. Ruskin Company.
    i. Vent Products Company, Inc.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:
    a. Hat-shaped, galvanized-steel channels, 16 gauge 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, 16 gauge 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.

2.3 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, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.4 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. Thermaflex.
2. Genflex
3. Thermold
4. Wiremold

B. Up to 2" W.G. Pressure Class:

1. Flexible duct shall be a factory assembly consisting of a spring steel helix, inner liner wrapped with 1" thick fiberglass insulation and a vapor barrier outer jacket. Composite assembly, including insulation and a vapor barrier, shall meet U.L. 181 and the Class 1 requirements of NFPA 90-A. Flexible duct shall be Thermaflex G-KKM, Thermold, Genflex or Wiremold.

C. 4" W.G. Pressure Class:

1. Flexible duct shall be a factory assembly consisting of a spring steel helix, inner liner wrapped with 1" thick fiberglass insulation and a vapor barrier outer jacket. Composite assembly, including insulation and a vapor barrier, shall meet U.L. 181 and the Class 1 requirements of NFPA 90-A. Flexible duct shall be equal to Thermaflex M-KC. Duct shall be designed for 4" pressure application.

D. Flexible Duct Clamps: Nylon strap in sizes 3 through 18 inches to suit duct size.

2.1 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. Elgen Manufacturing.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. McGill AirFlow LLC.
8. Nailor Industries Inc.
9. Pottorff.
10. Ventfabrics, Inc.
11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - 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-inchbutt 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: Continuous and two sash locks.
c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches.
d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.2 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.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

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 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.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install combination fire/smoke dampers according to UL listing.

G. 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. Adjacent to and close enough to combination fire/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.
3. Elsewhere as indicated.

H. Install access doors with swing against duct static pressure.

I. Access Door Minimum Sizes:

1. One-Hand or Inspection Access: 8 by 6 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

M. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

N. Connect diffusers or light troffer boots 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.

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 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.

END OF SECTION 23 33 00

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 wall ventilators.
2. Ceiling-mounted ventilators.
3. In-line centrifugal fans.
4. Vehicle exhaust equipment.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION 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. 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.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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.

1.8 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: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.9 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.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL WALL VENTILATORS

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

1. Acme Engineering & Manufacturing Corporation.
2. Aerovent; a division of Twin City Fan Companies, Ltd.
3. American Coolair Corporation.
4. Ammerman; Millennium Equipment.
5. Breidert Air Products.
6. Broan-NuTone LLC.
7. Broan-NuTone LLC; NuTone Inc.
8. Carnes Company.
9. Greenheck Fan Corporation.
10. Hartzell Fan Incorporated.
11. JencoFan.
12. Loren Cook Company.
13. PennBarry.
14. W.W. Grainger, Inc.; Dayton Products.

B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.

C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

D. 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.

E. Accessories:

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 fan housing, factory wired through internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Wall Grille: Ring type for flush mounting.
5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

F. Capacities and Characteristics:

1. As scheduled on the drawings.

2.2 IN-LINE CENTRIFUGAL FANS

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

1. Acme Engineering & Manufacturing Corporation.
2. American Coolair Corporation.
3. Ammerman; Millennium Equipment.
4. Breidert Air Products.
5. Carnes Company.
6. FloAire.
7. Greenheck Fan Corporation.
8. Hartzell Fan Incorporated.
9. JencoFan.
10. Loren Cook Company.
11. Madison Manufacturing.
12. PennBarry.
13. Quietaire Inc.

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing[**; with wheel, inlet cone, and motor on swing-out service door**].

D. 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.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories:

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. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

G. Capacities and Characteristics:

1. As scheduled on the drawings.

2. Vibration Isolators:

a. Fans 300 cfm and below: **Elastomeric hangers with static deflection of ½ inch**.
b. Fans over 300 cfm: Spring hangers with static deflection of 1 inch.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "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.

B. Enclosure Type: Totally enclosed, fan cooled.

2.4 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.

2.5 VEHICLE EXHAUST EQUIPMENT

A. Overhead Hose Reel
1. The hose reel shall be provided with a ¾ HP, 115/230/1 chain drive ODP motor assembly. The drive shaft shall be 1-1/2" diameter and be supported by two bearings, one at each end of the shaft. The bearings shall be a 4-bolt regreasable flanged type roller bearing.
2. The motor and drive assembly shall be covered by an 18-gauge mild steel enclosure. The enclosure shall have a removable access panel for motor servicing.
3. The hose reel side mounting support A frame shall be constructed of 10-gauge mild steel. The A frames shall be securely attached to a one-piece 10-gauge formed steel mounting frame. The top plate shall have 9/16" diameter holes for the mounting of the hose reel.
4. The hose drum shall be constructed of 16-gauge cold rolled steel. The drim shall be formed and rolled and strengthened by inner support bars. The drum shall be pulled tightly against the end flanges.
5. The drum end flanges shall be constructed of 12-gauge hot rolled steel. The end flanges outer lip shall have a rubber edge guard.

6. The drum end outlet collar and the A frame support outlet collar shall be formed from ¼" mild steel. The A-Frame support outlet collar ID shall be 1/16" larger that the of of the drum end collar.
7. A ¼" UHMW seal flange with a matching bolt hole pattern shall be furnished with the A-frame outlet collar. A steeve-type SOLID-LUBE self lubricating, self-aligning, bearing for extreme industrial applications shall be utilized. The bearing shall be rated for -40 F to 1000 F temperatures.
8. The hose reel drum shall be supplied with a hose tracking bar to guide the hose during the re-coiling function.
9. The entire hose reel shall be protected by a polyester power coating for corrosion resistance.
10. The motor operated hose reel shall be equipped with a manual override lever on the drive assembly.

B. Exhaust Hose
1. Double ply hose with an inner liner ply of woven fiberglass coated silicon rubber. A helically would spring steel wire imbedded between the inner liner ply and the exterior ply of woven Nomex, coated with silicone rubber. Hose to be rated for 80 F to 600 F continuous duty with intermittent temperature up to 1250 F.

2.6 Low Speed, Small Diameter (LSSD) overhead fans:

A. Entire fan assembly shall be UL/cUL-Listed to Underwriters Laboratory (UL) Standard 507 and CSA Standard 22.2 No. 113 to ensure compliance with the most current international testing standards. Intertek/ETL certification to UL Standard 507 and CSA Standard 22.2 No. 113 shall not be accepted.

B. Entire fan assembly shall be ENERGY STAR Certified for air performance and fan efficiency.

C. Fans are available in four sizes with nominal impeller diameters ranging from 52 inches through 84 inches (4.3-7 feet; 4-7 nominal fan sizes).

D. Performance capabilities up to 15,108 cubic feet per minute (cfm).

E. Maximum continuous operating temperature of 104° Fahrenheit (40° Celsius).

F. Designed for forward (counter-clockwise when viewed from floor) and reverse (clockwise when viewed from floor) operation capabilities, for comfort cooling and destratification applications.

G. Each fan shall bear a permanently affixed manufacturer's Mylar nameplate containing the model number, individual serial number, and electrical requirements of the fan.

H. Impeller:
1. Impeller shall be constructed of aerodynamic 6005A-T6 extruded aluminum airfoil blades connected to a single-piece, cast aluminum hub for structural strength. Multi-

piece hubs and plastic, resin, or wooden airfoil blades shall not be permitted. All connections shall be made using a minimum of SAE Grade 5 hardware.

2. Airfoil blades shall be fastened internally in the hub assembly with the fasteners hidden from the exterior of the fan.
3. Airfoil blades shall be provided with a mill aluminum finish as standard. Optional finishes shall include industrial powder coatings, anodize finishes, wood grain finishes, or custom color matched coatings.
4. Airfoil blades shall be optimized for maximum airflow, fan efficiency, and coverage area.
5. Airfoil blades shall be internally reinforced to minimize blade deflection while the fan is in standby or in operation. Blade deflection shall not exceed ±0.1 inches in either situation.
6. Airfoil blades shall be designed for minimal weight in order to maximize fan efficiency. Individual blade weight shall not exceed 3 pounds.
7. Impeller hub shall be secured to the face of the motor by a minimum of 5 bolts. Impeller hub shall also be connected to the building structure via a safety restraint cable and hub retaining ring.

I. Motor:
1. Motor enclosure: IP40
2. Motors shall be of the high torque, low speed direct drive type, carefully matched to the fan load and furnished at the specified voltage and phase. High speed motors provided with a gearbox to reduce the operating speed of the fan shall not be permitted.
3. Motors shall be an external rotor design. Internal rotor motors shall not be permitted.
4. Motors shall be of the brushless DC type for maximum efficiency and speed controllability. No other motor type shall be accepted.
5. Motors shall include wiring to the VFD that is installed by the factory to ensure proper function. Field-wiring between motors and VFDs shall not be permitted.
6. Motors shall include Class B insulation.

J. Variable Frequency Drive (VFD):
1. VFD enclosure: IP40
2. VFD shall be factory programmed and designed for Modbus RS-485 communication with control devices via the Modbus RTU communication protocol for communication reliability and ease of integration with a building management system (BMS). Infrared (IR) or 0-10VDC communication protocols shall not be permitted.
3. VFD shall be UL Listed for single phase input at the specified voltage.
4. VFD shall be provided with factory-installed, plug-and-play wiring for ease of installation. Plug-and-play wiring shall include power and communication wiring pigtails that are designed for quick and easy termination in the field.
5. VFD shall include thermistors for continuous monitoring of VFD's internal temperature.
6. VFD shall include sensors for continuous monitoring of voltage and current.
7. VFD shall include intelligent protection systems to prevent failures caused by over/under-voltage, over-current, over-temperature, and over-speed. VFDs without these protection features shall not be permitted.

8. VFD shall include the most current firmware version as of the product's manufacturing date to ensure optimal performance. As a result of continuous development, the manufacturer reserves the right to update VFD firmware without notice.

K. Universal Ceiling Mount and Downtube:
1. Fans shall be provided with a universal ceiling mount that is designed for fast and secure installation on a variety of building structures. Fans shall be capable of mounting to a fan-rated junction box (provided by others). Universal ceiling mount shall be constructed of heavy gauge steel and shall include a pivoting ball joint to accommodate pitches up to 4.5/12.
2. Downtube shall be constructed of heavy gauge steel to provide a structural connection between the universal ceiling mount and fan motor.
3. Universal ceiling mount and downtube shall be powder-coated for corrosion resistance and aesthetic appearance.
4. Standard drop length between top of universal ceiling mount and top of airfoil blades shall be 1 foot. Optional drop lengths are also available in a 3 foot or 6 foot length.

L. Options/Accessories:
1. Finishes:
   a. Anodized – Hard aluminum oxide coating.
2. Disconnect:
   a. NEMA 1
   b. Positive Electrical Shut-off
   c. Shipped loose for field mounting
3. Overhead Fan Controls:
   a. Type: Standard Touchscreen Control.
4. Controls shall be capable of operating one or multiple overhead fans as specified. Controls shall provide start/stop, speed, and rotation direction control capabilities as well as diagnostic and fault history information for each connected fan.
5. Controls shall include RJ45 ports for plug-and-play connection to overhead fans via CAT-5e communication cable in the field.

2.7 Direct Drive High Volume, Low Speed(HVLS) Overhead Fans:

A. High Volume, Low Speed (HVLS) overhead fans shall be licensed to bear the AMCA Certified Rating Seal for Circulating Fan Performance to ensure performance as cataloged in the field. Unlicensed overhead fans shall not be accepted.
1. Entire fan assembly (with or without the optional LED light kit) shall be UL/cUL-Listed to Underwriters Laboratory (UL) Standard 507 and CSA Standard 22.2 No. 113 to ensure compliance with the most current international testing standards. Intertek/ETL certification to UL Standard 507 and CSA Standard 22.2 No. 113 shall not be accepted.
2. Fans are available in four sizes with nominal impeller diameters ranging from 8 feet through 14 feet (8 - 14 unit sizes).
3. Performance capabilities up to 55,800 cubic feet per minute (cfm).

4. Maximum continuous operating temperature of 104° Fahrenheit (40° Celsius).
5. Designed for forward (counter-clockwise when viewed from floor) and reverse (clockwise when viewed from floor) operation capabilities, for comfort cooling and destratification applications.
6. Each fan shall bear a permanently affixed manufacturer's mylar nameplate containing the model number, individual serial number, and electrical requirements of the fan.

B. Impeller:
1. Impeller shall be constructed of aerodynamic 6005A-T6 extruded aluminum airfoil blades connected to a single-piece, laser-cut 5/16 inch steel hub for structural strength. Multi-piece hubs shall not be permitted. All connections shall be made using a minimum of SAE Grade 5 hardware.
2. Airfoil blades shall be interlocked with one another and the impeller hub via a heavy-duty steel airfoil retaining ring for safety. Airfoil retaining ring shall be constructed of heavy gauge steel and installed at the factory to ensure proper function. Field-installed airfoil retainers shall not be accepted.
3. Airfoil blades shall be provided with a mill aluminum finish as standard. Optional finishes shall include industrial powder coatings, anodize finishes, wood grain finishes, or custom color matched coatings.
4. Airfoil blades shall be optimized for maximum airflow, fan efficiency, and coverage area.
5. Airfoil blades shall be internally reinforced to minimize blade deflection while the fan is in standby or in operation. Blade deflection shall not exceed ±2.4 inches in either situation.
6. Airfoil blades shall be designed for minimal weight in order to maximize fan efficiency. Individual blade weight shall not exceed 10 pounds.
7. Impeller hub shall be secured to the face of the motor by a minimum of 6 bolts. Impeller hub shall also be connected to the building structure via a safety restraint cable and hub retaining ring. Hub retaining ring shall be constructed of heavy gauge steel and installed at the factory to ensure proper function.

C. Motor:
1. Motor enclosure: IP54
2. Motors shall be of the high torque, low speed direct drive type, carefully matched to the fan load and furnished at the specified voltage and phase. High speed motors provided with a gearbox to reduce the operating speed of the fan shall not be permitted.
3. Motors shall be an external rotor design. Internal rotor motors shall not be permitted.
4. Motors shall be of the brushless DC type for maximum efficiency and speed controllability. No other motor type shall be accepted.
5. Motors shall include plug-and-play connectors for all wiring to the variable frequency drive. Motors that require these wiring connections to be stripped and terminated in the field shall not be permitted.
6. Motors shall include an internally-mounted thermistor for continuous monitoring of the motor's internal temperature.
7. Motors shall include Class B insulation.

D. Variable Frequency Drive (VFD):
   1. VFD enclosure: IP50
   2. VFD shall be factory programmed and designed for Modbus RS-485 communication with control devices via the Modbus RTU communication protocol.
   3. VFD shall be UL Listed for single phase input at the specified voltage.
   4. VFD shall be provided with factory-installed, plug-and-play wiring for ease of installation. Plug-and-play wiring shall include power, communication, and fire alarm wiring pigtails that are designed for quick and easy termination in the field.
   5. VFD shall be factory-wired for power and control of LED light when fan is supplied with optional LED light kit.
   6. VFD shall include two thermistors for continuous monitoring of VFD's internal and external temperature.
   7. VFD shall include sensors for continuous monitoring of voltage and current.
   8. VFD shall include intelligent protection systems to prevent failures caused by over/under-voltage, over-current, over-temperature, over-speed, and fan impact. VFDs without these protection features shall not be permitted.
   9. VFD shall include the most current firmware version as of the product's manufacturing date to ensure optimal performance. As a result of continuous development, the manufacturer reserves the right to update VFD firmware without notice.

E. Universal Ceiling Mount & Downtube:
   1. Fans shall be provided with a universal ceiling mount that is designed for fast and secure installation on a variety of building structures. Universal ceiling mount shall be constructed of heavy gauge, bolted steel and shall include a pivoting knuckle joint with one axis of rotation to accommodate any ceiling pitch.
   2. Downtube shall be constructed of heavy gauge steel to provide a structural connection between the universal ceiling mount and fan motor. Downtube shall also include a welded guy wire connection ring for fast and secure installation of guy wires when required based on downtube length.
   3. Universal ceiling mount and downtube shall be powder-coated for corrosion resistance and aesthetic appearance.
   4. Standard drop length between top of universal ceiling mount and top of airfoil blades shall be 2 feet. Optional drop lengths are also available in one foot increments between 3 and 10 feet.
   5. All hardware shall be a minimum of SAE Grade 5.

F. Options/Accessories:
   1. Finishes:
      a. Anodized – Hard aluminum oxide coating.
   2. Disconnect:
      a. NEMA 1
      b. Positive Electrical Shut-off
      c. Shipped loose for field mounting
   3. Overhead Fan Controls:
      a. Type: Standard Touchscreen Control.

4. Controls shall be capable of operating one or multiple overhead fans as specified. Controls shall provide start/stop, speed, and rotation direction control capabilities as well as diagnostic and fault history information for each connected fan.
5. Controls shall include RJ45 ports for plug-and-play connection to overhead fans via CAT-5e communication cable in the field.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

C. Support suspended units from structure using threaded steel rods.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

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 Section 230593 "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 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. Modular core supply grilles.
2. Adjustable bar registers and grilles.
3. Fixed face registers and grilles.

B. Related Sections:

1. Section 089116 "Operable Wall Louvers" and Section 089119 "Fixed Louvers" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION 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. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.

2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Louver Face Diffuser:

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

    a. Anemostat Products; a Mestek company.
    b. Carnes.
    c. Krueger
    d. METALAIRE, Inc.
    e. Nailor Industries Inc.
    f. Price Industries.
    g. Titus.
    h. Tuttle & Bailey.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: As scheduled
4. Finish: Baked enamel, white.
5. Mounting: Surface with beveled frame or T-bar with Mounting panel as scheduled.
6. Pattern: Adjustable core style.
7. Dampers: As scheduled.
8. Accessories:

    a. Square to round neck adaptor.

2.2 REGISTERS AND GRILLES

A. Adjustable Bar Grille:

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

    a. A-J Manufacturing Co., Inc.
    b. Anemostat Products; a Mestek company.
    c. Carnes.

d. Dayus Register & Grille Inc.
e. Hart & Cooley Inc.
f. Krueger.
g. METALAIRE, Inc.
h. Nailor Industries Inc.
i. Price Industries.
j. Titus.
k. Tuttle & Bailey.

2. Material: Steel or Aluminum as scheduled.
3. Finish: Baked enamel, white unless noted otherwise**.**
4. Face Blade Arrangement: Horizontal 3/4 inch apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
7. Frame: 1 inch wide.

B. Fixed Face Grille:

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

a. A-J Manufacturing Co., Inc.
b. Anemostat Products; a Mestek company.
c. Carnes.
d. Dayus Register & Grille Inc.
e. Hart & Cooley Inc.
f. Krueger.
g. METALAIRE, Inc.
h. Nailor Industries Inc.
i. Price Industries.
j. Titus.
k. Tuttle & Bailey.

2. Material: Steel or Aluminum as scheduled.
3. Finish: Baked enamel, white unless noted otherwise**.**
4. Face Blade Arrangement: Horizontal 3/4 inch apart.
5. Core Construction: Integral.
6. Frame: 1 inch wide.

2.3 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 23 72 00 - 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. Outdoor Packaged energy recovery units.

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 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, 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.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Suspended ceiling components.
   2. Structural members to which equipment or suspension systems will be attached.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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 of each type of filter specified.

1.8 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:
   1. Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment."
   2. Capacity ratings for air coils shall comply with ARI 410, "Forced-Circulation Air- Cooling and Air-Heating Coils."

C. ASHRAE Compliance:
   1. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
   2. 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:
   1. Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."
   2. Electric coils shall comply with requirements in UL 1995, "Heating and Cooling Equipment."

1.9 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.

PART 2 - PRODUCTS

2.1 OUTDOOR PACKAGED ENERGY RECOVERY UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. AAON
   2. DAIKIN
   3. Engineered Air.
   4. Greenheck Fan Corporation.
   5. RenewAire LLC.
   6. Trane; American Standard Companies, Inc.
   7. Venmar CES Inc.

B. Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, outdoor air intake weather hood with metal mesh filters, energy wheel, motorized intake damper, motorized exhaust damper, sensors, curb assembly, service receptacle, frost control, filter assembly for intake and exhaust air, supply air blower assembly, exhaust air blower assembly and an electrical control center. All specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection.

C. CABINET
   1. Materials: Formed single wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
      a. Outside casing: 18 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish. Corrosion rates can vary greatly depending on environmental factors, yet it is common acceptance that the life of zinc is a linear function of the coating mass. To obtain a higher life expectancy for an application, the user should utilize twice the coating mass. Ex. A G90 coating mass will exhibit approximately 150% longer life than the G30 coating. [Unit's exterior shall be supplied from the manufacturer using G60 galvaneal steel with proprietary pre-painted material in the following finish color; Concrete Gray-RAL 7023. This has been subjected to a salt spray test per ASTM-B117 and evaluated using ASTM-D714 and ASTM-D610 showing no observable signs of rust or blistering until reaching 2,500 hours.] This is Greenheck's PermatectorTM option. [Unit's exterior shall be supplied from the manufacturer using G60 galvaneal steel with a baked enamel finish.] Greenheck's baked enamel finish is available in 7 standard colors with a match color chip option. Enamel coatings offer good color and gross retention in exterior applications and have reasonably to excellent chemical resistance properties, further performance information can be supplied upon request. [Unit's exterior shall be supplied from the manufacturer using G60 galvaneal steel with a high performance proprietary coating that has been subjected to a salt spray test per ASTM-B117 and evaluated using ASTM-D714 and ASTM-D610 showing no observable signs of rust or blistering until reaching 5,000

hours.] Greenheck's high performance coating (Hi-Pro Poly) is only available in the following finish color; Concrete Gray-RAL 7023.]

b. Internal assemblies: [18 gauge, galvanized (G90) steel] except for motor supports which shall be minimum14 gauge galvanized (G90) steel.

2. Access doors shall be hinged.
3. Shall have factory-installed duct flanges on all duct openings.
4. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
   a. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
      1) Thickness: 1 inch (25 mm)
      2) Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
      3) Location and application: Full coverage of entire cabinet exterior to include walls, roof and floor of unit. Insulation shall be of semi-rigid type and installed between inner and outer shells of all cabinet exterior components.
5. Energy wheel: Energy wheel shall be of total enthalpy, rotary air-to-air type and shall be an element of a removable energy wheel cassette. The cassette shall consist of a galvanized steel framework (designed to produce laminar air flow through the wheel), an energy wheel as specified and a motor and drive assembly. The cassette shall incorporate a pre-tensioned drive belt with a five-year warranty. Note to A/E: Various energy wheel manufacturers are known to build non-segmented wheels. Segmented wheels are known to provide substantial time and labor-saving benefits over the entire life of the energy wheel. The wheel media shall be a polymer film matrix in a stainless-steel framework and be comprised of individual segments that are removable for servicing. Non-segmented energy wheels are not acceptable. Silica gel desiccant shall be permanently bonded to the polymer film and shall be designed and constructed to permit cleaning and servicing. The energy wheel is to have a five-year warranty. Performance criteria are to be as specified in AHRI Standard 1060, complying with the Combined Efficiency data in the submittal.
6. Supply Air and Exhaust Air blower assemblies: Blower assemblies consist of an electric motor as specified by A/E and a belt driven blower. Assembly shall be mounted on heavy gauge galvanized rails and further mounted on 1.125-inch-thick neoprene vibration isolators.
7. Control panel / connections: Energy Recovery Ventilator shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections
8. Frost control: modulating wheel.
9. Modulating frost control. Control system shall include an outdoor air thermostat and pressure sensor on the wheel assembly to initiate frost control sequence.
10. Motorized dampers / Exhaust Air, Intake Air: Motorized dampers of low leakage type shall be factory installed.

D. BLOWER

1. Blower section construction, Supply Air and Exhaust Air: Belt drive motor and blower shall be assembled onto a 14-gauge galvanized steel platform and must have neoprene vibration isolation devices.

2. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
3. Centrifugal blower housing: Formed and reinforced steel panels to make curved scroll housing with shaped cutoff.
4. Forward curved blower (fan) wheels: Galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow. Mechanically attached to shaft with set screws.
5. Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".

E. MOTORS
1. General: Minimum compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts. Electric motors of ten horsepower or less shall be supplied with an adjustable drive pulley. Comply with requirements in Division 23 05 13, matched with fan load.
2. Motors shall be 60 cycle, 1 phase 240 volts. The designation "NEMA Premium™" applies to electric motors with efficiencies that are "better than EPAct". The terms "high efficiency" or "premium efficiency" have no industry definitions.

F. UNIT CONTROLS:
1. This unit shall be controlled by a factory-installed microprocessor programmable controller that is connected to various optional sensors.
2. Sensors
   a. Dirty Filter Sensor
   b. Temperature Sensors- Supply Air
   c. Rotation Sensor

G. FILTERS
1. MERV8 disposable pleated filters shall be provided in the intake air stream and MERV8 filters in the exhaust air stream]. Note: 2" thick MERV 8 filters are standard.

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-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. Equipment Mounting: Install air-to-air energy recovery equipment on concrete bases. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete." or Section 033053 "Miscellaneous 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.

B. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install units with clearances for service and maintenance.

D. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

E. Pipe drains from drain pans to nearest floor drain; use ASTM B 88, Type L, drawn-temper copper water tubing with soldered joints, same size as condensate drain connection.

F. Pipe drains from drain pans to nearest floor drain; use ASTM D 1785, Schedule 40 PVC pipe and solvent-welded fittings, same size as condensate drain connection.
   1. Requirements for Low-Emitting Materials:
      a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Requirements for Low-Emitting Materials: Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 232113 "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to unit to allow service and maintenance.

C. Connect piping to units mounted on vibration isolators with flexible connectors.

D. Comply with requirements for ductwork specified in Section 233113 "Metal Ducts."

E. Install electrical devices furnished with units but not factory mounted.

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. 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.

C. 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.

D. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

END OF SECTION 23 72 00

SECTION 237339 - OUTDOOR, ELECTRIC 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 with an evaporative cooling package.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof-mounted units and roof-curb mounting details drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Size and location of rooftop unit mounting rails and anchor points and methods for anchoring units to curb.
2. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.

B. Startup service reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For direct-fired H&V units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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(s) for each unit.

2. Fan Belts: One set(s) for each unit.

1.7 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 Section 016000 "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, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate size, location, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

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. ARES; Mars Air Products.
2. Captive-Air Systems, Inc.
3. CES Group; Ventrol Air Handling Systems, Inc.
4. Engineered Air.
5. Greenheck.
6. Hastings Industries; Division of Eric, Inc.
7. LC Systems.
8. Modine Mfg. Co.; Commercial HVAC&R Division.
9. Reznor-Thomas & Betts Corporation; Mechanical Products Division.
10. Trane Company (The); Unitary Products Group.

2.2 PACKAGED UNITS

A. Factory-assembled, prewired, self-contained unit consisting of cabinet, supply fan, controls, filters, evaporative cooling package, 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: Piano hinged with cam-lock fasteners 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] [furnace and fan sections only].

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. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

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**,** self-aligning, permanently lubricated ball bearings.

B. Motor: Open dripproof, variable-speed 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. Disposable Panel Filters: 2-inch- thick, factory-fabricated, flat-panel-type, disposable air filters with holding frames, with a minimum MERV 8 rating

1. Media: Interlaced glass or polyester fibers.

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 ELECTRIC FURNACE

A. Description: Factory assembled and wired SCR heating coil.

B. Inside Unit External Housing: Steel cabinet with integral support inserts.

C. Coils: Open air coils.

1. Control: SCR Modulating heat.
2. Fuel: Electric.

D. Safety Controls:
1. Airflow Proving Switch: Dual pressure switch senses correct airflow before energizing coil and requires airflow to be maintained within minimum and maximum pressure settings.
2. Manual-Reset, High-Limit Control Device: Stops heater and disengages electric heat if high-limit temperature is exceeded.
3. Control Transformer: Integrally mounted 24-V ac.

2.8 EVAPORATIVE COOLING PACKAGE

A. Cabinet: Single-wall, galvanized- or aluminized-steel panels, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs and having a stainless-steel reservoir with overflow and drain with full-port, brass-fitted ball valve.

1. External Casing and Cabinet Finish: Baked enamel or Powder coating over corrosion-resistant-treated surface in color to match fan section.

B. Media: UL 900, Class 2, 12-inch- thick cellulose media with rigidizing agents, fungicides, and wetting agents. Minimum 90 percent contact factor.

1. Moisture elimination pad.

C. Water-Circulation System: Submersible centrifugal sump pump with inlet strainer, brass balancing valve located in pump discharge, and thermally protected motor; water distribution troughs or piping at top of media pads; and float-operated, makeup water and bleed-off valves.

1. Automatic Fill and Drain Kit: Water supply and drain, solenoid valves for initial sump fill and for draining sump.

D. Water-Saver System: Timer, solenoid valve, and water distribution piping to apply the water supply to the media.

E. Comply with applicable requirements in ASHRAE 62.1.

2.9 CONTROLS

A. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote control panel.

B. Control Panel: Surface-mounted remote panel, with engraved plastic cover, and the following lights and switches:

1. On-off-auto switch.
2. Automatic changeover.
3. Supply-fan operation indicating light.
4. Heating operation indicating light.
5. Damper position potentiometer.
6. Thermostat.
7. Cooling operation indicating light.
8. Dirty-filter indicating light operated by unit-mounted differential pressure switch.
9. Safety-lockout indicating light.

C. Control Devices:

1. Remote Thermostat: Adjustable room thermostat with temperature readout.
2. Remote Setback Thermostat: Adjustable room thermostat without temperature readout.
3. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
4. Fire-Protection Thermostats: Fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature.
5. Timers: Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch trippers; minimum of two and maximum of

eight signals per day with two normally open and two normally closed output contacts.

6. Timers: Solid-state, programmable time control with 4 separate programs; 24-hour battery carryover; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; and system fault alarm.
7. 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.
8. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed. Equip with filtered circuit to eliminate radio interference.

D. Fan Control: Interlock fan to start with exhaust fan(s).

E. Fan Control: Timer starts and stops direct-fired H&V unit and exhaust fan(s).

1. Fan-Discharge Thermostat: Stops fan when discharge-air temperature is less than 40 deg F.
2. Smoke detectors, located in supply air, shall stop fans when the presence of smoke is detected.
3. Controls **variable**]-speed motor controller using static-pressure transmitter.

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: Operates gas valve to maintain supply-air temperature.

1. Operates gas valve to maintain discharge-air temperature with factory-mounted sensor in fan outlet.
2. Timer shall select remote setback thermostat to maintain space temperature at 50 deg F.

H. Evaporative Cooling Controls:

1. Start and stop water-circulation-system sump pump to maintain space temperature.
2. Automatic Fill Control: A switch in the unit control panel shall close sump drain valve and open makeup water valve.
3. Automatic Drain Control: Opens sump drain valve and closes makeup water valve when an outside thermostat senses 40 deg F or less.
4. Water-Saver System: Remote thermostat shall open water-supply valve to maintain dry-bulb temperature in space. Timer shall activate thermostat circuit.

2.10 MOTORS

A. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.11 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 suspended units from spring hangers with minimum 1-inch static deflection."

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 Section 231123 "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.
2. Makeup Water: Comply with requirements in Section 221116 "Domestic Water Piping" for valves and accessories on piping connections to evaporative cooling units.
3. Drain: Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for traps and accessories on piping connections to evaporative cooling units.

B. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply[**and return**] ducts to direct-fired H&V units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "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. Calibrate thermostats.
17. Adjust and inspect high-temperature limits.
18. Inspect dampers, if any, for proper stroke and interlock with return-air dampers.
19. Start evaporative cooler system and measure and record the following:

    a. Leaving-air, dry- and wet-bulb temperatures.
    b. Entering-air, dry- and wet-bulb temperatures.

20. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.

21. Measure and record airflow. Plot fan volumes on fan curve.
22. Verify operation of remote panel, including pilot-operation and failure modes. Inspect the following:

    a. High-limit heat.
    b. Alarms.

23. 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.

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. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain direct-fired H&V units. Refer to Section 017700 "Closeout Procedures." or Section 017900 "Demonstration and Training."

END OF SECTION 237339

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS AND HEAT 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. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

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

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 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:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate sizes and locations of ground curbs, equipment supports, and wall penetrations with actual equipment provided.

1.8 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:

a. For Compressor: One year(s) from date of Substantial Completion.
b. For Parts: One year(s) from date of Substantial Completion.
c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
2. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
3. Trane; a business of American Standard companies.
4. Samsung

5. LG
6. Daiken

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
4. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
5. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    c. Wiring Terminations: Connect motor to chassis wiring with plug connection.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Filters: Permanent, cleanable.
8. Condensate Drain Pans:

    a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

        1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
        2) Depth: A minimum of 2 inches deep.

    b. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
    c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.

        1) Minimum Connection Size: NPS 3/4".

    d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
    e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. 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.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Scroll.
    b. Multi-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
    c. Refrigerant Charge: R-410a.
    d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to -13 deg F.
7. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Control equipment and sequence of operation to be packaged controls capable of providing sequence of operation dictated in drawings.

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.

D. Branch Boxes: Where indicated and scheduled on plans provide branch distribution unit with required number of ports.

E. Drain Hose: For condensate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install indoor units level and plumb with wall mounting hardware or ceiling mount hangers.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to concrete housekeeping pad.

C. Anchor units to supports with removable, cadmium-plated fasteners.

D. Install compressor-condenser components level and plumb on concrete pads provided. Concrete pad shall extend beyond unit a minimum of 12 inches on all sides.

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 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 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. 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.

C. Tests and Inspections:

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.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

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. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. PTFE: Polytetrafluoroethylene plastic.

C. TFE: Tetrafluoroethylene plastic.

1.4 ACTION 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. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.

6. Perimeter moldings for exposed or partially exposed cabinets.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.7 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 WALL AND CEILING 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:

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

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

1. Berko Electric Heating; a division of Marley Engineered Products.
2. Chromalox, Inc.; a division of Emerson Electric Company.
3. Indeeco.
4. Markel Products; a division of TPI Corporation.
5. Marley Electric Heating; a division of Marley Engineered Products.
6. Ouellet Canada Inc.
7. QMark Electric Heating; a division of Marley Engineered Products.
8. Trane.

D. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

E. Cabinet:

1. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

F. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.

G. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.

H. Fan: Aluminum propeller directly connected to motor.

1. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

I. Controls: Unit-mounted thermostat.

J. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

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 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 wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."

B. Install cabinet unit heaters to comply with NFPA 90A.

C. Install propeller unit heaters level and plumb.

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. Comply with safety requirements in UL 1995.

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. 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. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. 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. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 238239

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Single conductor building wire.

B. Underground feeder and branch-circuit cable.

C. Service entrance cable.

D. Power and control tray cable.

E. Variable-frequency drive cable.

F. Photovoltaic wire.

G. Manufactured wiring systems.

H. Wiring connectors.

I. Electrical tape.

J. Heat shrink tubing.

K. Wire pulling lubricant.

L. Cable ties.

M. Firestop sleeves.

1.2 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

C. Section 26 05 36 - Cable Trays for Electrical Systems: Additional installation requirements for cables installed in cable tray systems.

D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 21 00 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.

F. Section 26 31 00 - Photovoltaic Collectors: Additional wiring requirements for photovoltaic systems.

G. Section 28 46 00 - Fire Detection and Alarm: Fire alarm system conductors and cables.

1.3 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).

E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.

F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2020.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.

I. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. NFPA 79 - Electrical Standard for Industrial Machinery; 2021.

L. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.

M. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.

N. UL 183 - Manufactured Wiring Systems; Current Edition, Including All Revisions.

O. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.

P. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.

Q. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

R. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.

S. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.

T. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

U. UL 854 - Service-Entrance Cables; Current Edition, Including All Revisions.

V. UL 2277 - Outline of Investigation for Flexible Motor Supply Cable and Wind Turbine Tray Cable; Current Edition, Including All Revisions.

W. UL 4703 - Standard for Photovoltaic Wire; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.

2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.

3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Wire Pulling Lubricant: Certification of compatibility with conductors/cables where used with the following insulation/jacket types:

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 – PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

1. Exceptions:

a. Use manufactured wiring systems for branch circuits where concealed under raised floors.

1) Exception: Provide single conductor building wire in raceway for circuit homerun from distribution box to panelboard.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Service entrance cable is not permitted.

1. Where not otherwise restricted, may be used:

a. For overhead service drop, installed in raceway to service head.

b. For underground service entrance, installed in raceway.

2. In addition to other applicable restrictions, may not be used:

a. Where exposed to damage.

F. Armored cable is not permitted.

G. Metal-clad cable is not permitted.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.

H. Conductor Material:

1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.

2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.

3. Tinned Copper Conductors: Comply with ASTM B33.

I. Minimum Conductor Size:

1. Branch Circuits: 12 AWG.

a. Exceptions:

1) 20 A, 120 V circuits longer than 75 feet (23 m): 10 AWG, for voltage drop.

2) 20 A, 120 V circuits longer than 150 feet (46 m): 8 AWG, for voltage drop.

2. Control Circuits: 14 AWG.

J. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

K. Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.

2. Color Coding Method: Integrally colored insulation.

a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.

3. Color Code:

a. 208Y/120 V, 3 Phase, 4 Wire System:

1) Phase A: Black.

2) Phase B: Red.

3) Phase C: Blue.

4) Neutral/Grounded: White.

b. Equipment Ground, All Systems: Green.

c. Isolated Ground, All Systems: Green with yellow stripe.

d. Travelers for 3-Way and 4-Way Switching: Pink.

e. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.

f. For control circuits, comply with manufacturer's recommended color code.

2.3 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:

1. Copper Building Wire:

a. Cerro Wire LLC: www.cerrowire.com/#sle.

b. Encore Wire Corporation: www.encorewire.com/#sle.

c. General Cable Technologies Corporation: www.generalcable.com/#sle.

d. Southwire Company: www.southwire.com/#sle.

e. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:

1. Feeders and Branch Circuits:

a. Size 10 AWG and Smaller: Solid.

b. Size 8 AWG and Larger: Stranded.

2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:

1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.

a. Size 4 AWG and Larger: Type XHHW-2.

b. Installed Underground: Type XHHW-2.

2.4 VARIABLE-FREQUENCY DRIVE CABLE

A. Manufacturers:

1. Service Wire Co; ServiceDrive: www.servicewire.com/#sle.

B. Description: Flexible motor supply cable listed and labeled as complying with UL 2277 in accordance with NFPA 79; specifically designed for use with variable frequency drives and associated nonlinear power distortions.

C. Conductor Stranding: Stranded.

D. Insulation Voltage Rating: 1000 V.

E. Insulation: Use only thermoset insulation types; thermoplastic insulation types are not permitted.

F. Grounding: Full-size integral equipment grounding conductor or symmetrical arrangement of multiple conductors of equivalent size.

G. Provide metallic shielding.

H. Jacket: PVC or Chlorinated Polyethylene (CPE).

2.5 MANUFACTURED WIRING SYSTEMS

A. Description: Manufactured wiring assemblies complying with NFPA 70 Article 604, and listed and labeled as complying with UL 183.

B. Provide components necessary to transition between manufactured wiring system and other wiring methods.

C. Branch Circuit Cables:

1. Conductor Stranding (Size 10 AWG and Smaller): Solid.

2. Insulation Voltage Rating: 600 V.

3. Insulation: Type THHN.

4. Grounding: Full-size integral equipment grounding conductor.

5. Armor: Steel, interlocked tape.

D. Connectors: Keyed and color-coded to prevent interconnection of different voltages.

E. Fixture Leads: Type TFN insulation.

2.6 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.

C. Wiring Connectors for Splices and Taps:

1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.

2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D. Wiring Connectors for Terminations:

1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.

2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.

3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.

4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.

5. Copper Conductors Size 8 AWG and Larger: Use compression connectors where connectors are required.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

1. Manufacturers:

a. 3M: www.3m.com/#sle.

b. Ideal Industries, Inc: www.idealindustries.com/#sle.

c. NSI Industries LLC: www.nsiindustries.com/#sle.

d. Substitutions: See Section 01 60 00 - Product Requirements.

H. Mechanical Connectors: Provide bolted type or set-screw type.

I. Compression Connectors: Provide circumferential type or hex type crimp configuration.

1. Manufacturers:

a. Burndy LLC: www.burndy.com/#sle.

b. Thomas & Betts Corporation: www.tnb.com/#sle.

c. Substitutions: See Section 01 60 00 - Product Requirements.

J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

1. Manufacturers:

a. Burndy LLC: www.burndy.com/#sle.

b. Ilsco: www.ilsco.com/#sle.

c. Thomas & Betts Corporation: www.tnb.com/#sle.

d. Substitutions: See Section 01 60 00 - Product Requirements.

2.7 ACCESSORIES

A. Electrical Tape:

1. Manufacturers:

a. 3M: www.3m.com/#sle.

b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.

c. Substitutions: See Section 01 60 00 - Product Requirements.

2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F (105 degrees C).

    a. Substitutions: See Section 01 60 00 - Product Requirements.

3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).

    a. Substitutions: See Section 01 60 00 - Product Requirements.

4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil (0.76 mm); suitable for continuous temperature environment up to 194 degrees F (90 degrees C) and short-term 266 degrees F (130 degrees C) overload service.

    a. Substitutions: See Section 01 60 00 - Product Requirements.

5. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil (2.3 mm).

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

1. Manufacturers:

    a. 3M: www.3m.com/#sle.

    b. Burndy LLC: www.burndy.com/#sle.

    c. Thomas & Betts Corporation: www.tnb.com/#sle.

C. Wire Pulling Lubricant:

1. Manufacturers:

    a. 3M: www.3m.com/#sle.

    b. American Polywater Corporation: www.polywater.com/#sle.

    c. Ideal Industries, Inc: www.idealindustries.com/#sle.

d. Substitutions: See Section 01 60 00 - Product Requirements.

2. Listed and labeled as complying with UL 267.

3. Suitable for use with conductors/cables and associated insulation/jackets to be installed.

4. Suitable for use at installation temperature.

5. Products:

a. American Polywater Corporation; Polywater J Cable Pulling Lubricant: www.polywater.com/#sle.

b. American Polywater Corporation; Polywater LZ Cable Pulling Lubricant: www.polywater.com/#sle.

c. Substitutions: See Section 01 60 00 - Product Requirements.

D. Cable Ties: Material and tensile strength rating suitable for application.

1. Manufacturers:

a. Burndy LLC: www.burndy.com/#sle.

b. Substitutions: See Section 01 60 00 - Product Requirements.

E. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.

1. Products:

a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.

b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.

c. Substitutions: See Section 01 60 00 - Product Requirements.

F. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

1. Products:

a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.

b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.

2. When circuit destination is indicated without specific routing, determine exact routing required.

3. Arrange circuiting to minimize splices.

4. Include circuit lengths required to install connected devices within 10 ft (3.0 m) of location indicated.

5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.

6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.

7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.

a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.

b. Increase size of conductors as required to account for ampacity derating.

c. Size raceways, boxes, etc. to accommodate conductors.

8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

a. Branch circuits fed from ground fault circuit interrupter (GFCI) circuit breakers.

b. Branch circuits fed from feed-through protection of GFI receptacles.

c. Branch circuits with dimming controls.

d. Branch circuits with isolated grounding conductor.

9. Provide oversized neutral/grounded conductors where indicated and as specified below.

a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.

b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Installation in Raceway:

1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.

2. Pull all conductors and cables together into raceway at same time.

3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.

4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.

G. Variable-Frequency Drive Cable: Terminate shielding at both variable-frequency motor controller and associated motor using glands or termination kits recommended by manufacturer.

H. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.

I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

K. Make wiring connections using specified wiring connectors.

1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.

2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.

3. Do not remove conductor strands to facilitate insertion into connector.

4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.

5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

L. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.

    a. For taped connections, first apply adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.

2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.

    a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.

    b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.

3. Wet Locations: Use heat shrink tubing.

M. Insulate ends of spare conductors using vinyl insulating electrical tape.

N. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

O. Identify conductors and cables in accordance with Section 26 05 53.

P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.

1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 26 05 19

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

F. Ground enhancement material.

G. Ground access wells.

1.2 RELATED REQUIREMENTS

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

C. Section 26 56 00 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.3 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.

D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify exact locations of underground metal water service pipe entrances to building.

2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.

3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Field quality control test reports.

E. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 – PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Grounding System Resistance:

1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.

2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.

3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

E. Grounding Electrode System:

1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.

a. Provide continuous grounding electrode conductors without splice or joint.

b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.

2. Metal Underground Water Pipe(s):

a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet (3.0 m) at an accessible location not more than 5 feet (1.5 m) from the point of entrance to the building.

b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.

c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.

3. Metal In-Ground Support Structure:

a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.

4. Concrete-Encased Electrode:

a. Provide connection to concrete-encased electrode consisting of not less than 20 feet (6.0 m) of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.

5. Ground Rod Electrode(s):

a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.

b. Space electrodes not less than 10 feet (3.0 m) from each other and any other ground electrode.

c. Where location is not indicated, locate electrode(s) at least 5 feet (1.5 m) outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.

d. Provide ground enhancement material around electrode where indicated.

e. Provide ground access well for each electrode.

6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.

7. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.

    a. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.

    b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.

    c. Ground Bar Mounting Height: 18 inches (450 mm) above finished floor unless otherwise indicated.

8. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.

F. Service-Supplied System Grounding:

1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.

2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

G. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:

1. Provide grounding electrode system for each separate building or structure.

2. Provide equipment grounding conductor routed with supply conductors.

3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.

4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.

H. Separately Derived System Grounding:

1. Separately derived systems include, but are not limited to:

a. Transformers (except autotransformers such as buck-boost transformers).

b. Uninterruptible power supplies (UPS), when configured as separately derived systems.

c. Generators, when neutral is switched in the transfer switch.

2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.

3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.

4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.

5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.

6. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.

7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

I. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.

2. Raceways may be used as sole equipment grounding conductor where permitted by NFPA 70. Provide insulated equipment grounding conductor where indicated or required, including but not limited to:

a. In each nonmetallic feeder and branch circuit raceway.

b. In each flexible conduit.

c. In outdoor portions of each metallic feeder and branch circuit raceway utilizing non-threaded fittings (where permitted) supplying rooftop multimotor and combination-load air-conditioning and refrigerating equipment.

3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.

4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.

6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.

7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:

a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.

b. Metal gas piping.

c. Metal process piping.

8. Provide bonding for interior metal air ducts.

9. Provide bonding for metal building frame.

10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.

11. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.

J. Isolated Ground System:

1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.

2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.

3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.

K. Communications Systems Grounding and Bonding:

1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.

2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.

a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.

b. Raceway Size: 3/4 inch (21 mm) trade size unless otherwise indicated or required.

c. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.

d. Ground Bar Mounting Height: 18 inches (450 mm) above finished floor unless otherwise indicated.

L. Pole-Mounted Luminaires: Also comply with Section 26 56 00.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

1. Provide products listed, classified, and labeled as suitable for the purpose intended.

2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:

1. Use insulated copper conductors unless otherwise indicated.

a. Exceptions:

1) Use bare copper conductors where installed underground in direct contact with earth.

2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.

2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.

a. Exceptions:

3. Unless otherwise indicated, use compression connectors for accessible connections.

a. Exceptions:

1) Use exothermic welded connections for connections to metal building frame.

4. Manufacturers - Mechanical and Compression Connectors:

a. allG Fabrication: www.allgfab.com/#sle.

b. Burndy LLC: www.burndy.com/#sle.

c. Harger Lightning & Grounding: www.harger.com/#sle.

d. nVent ERICO: www.nvent.com/#sle.

e. Thomas & Betts Corporation: www.tnb.com/#sle.

f. Substitutions: See Section 01 60 00 - Product Requirements.

5. Manufacturers - Exothermic Welded Connections:

a. Burndy LLC: www.burndy.com/#sle.

b. nVent ERICO; Cadweld: www.nvent.com/#sle.

c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.

d. Substitutions: See Section 01 60 00 - Product Requirements.

D. Ground Bars:

1. Description: Copper rectangular ground bars with mounting brackets and insulators.

2. Size: As indicated.

3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:

1. Comply with NEMA GR 1.

2. Material: Copper-bonded (copper-clad) steel.

3. Size: 3/4 inch (19 mm) diameter by 10 feet (3.0 m) length, unless otherwise indicated.

4. Where rod lengths of greater than 10 feet (3.0 m) are indicated or otherwise required, sectionalized ground rods may be used.

5. Manufacturers:

a. allG Fabrication: www.allgfab.com/#sle.

b. Harger Lightning & Grounding: www.harger.com/#sle.

c. nVent ERICO: www.nvent.com/#sle.

d. Substitutions: See Section 01 60 00 - Product Requirements.

F. Ground Enhancement Material:

1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.

2. Resistivity: Not more than 20 ohm-cm in final installed form.

3. Manufacturers:

a. Harger Lightning & Grounding: www.harger.com/#sle.

b. nVent ERICO; GEM: www.nvent.com/#sle.

c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.

d. Substitutions: See Section 01 60 00 - Product Requirements.

G. Ground Access Wells:

1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.

a. Areas Exposed to Vehicular Traffic: Rated for not less than vertical design load.

2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.

a. Round Wells: Not less than 8 inches (200 mm) in diameter.

3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches (250 mm).

4. Cover: Factory-identified by permanent means with word "GROUND".

5. Manufacturers:

a. allG Fabrication: www.allgfab.com/#sle.

b. Harger Lightning & Grounding: www.harger.com/#sle.

c. nVent ERICO: www.nvent.com/#sle.

d. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.

e. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.

1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches (150 mm) below finished grade.

2. Indoor Installations: Unless otherwise indicated, install with 4 inches (100 mm) of top of rod exposed.

D. Make grounding and bonding connections using specified connectors.

1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.

2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.

3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.

4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 26 05 26

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 05 50 00 - Metal Fabrications: Materials and requirements for fabricated metal supports.

C. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

D. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

E. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.

F. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

G. Section 26 56 00 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

H. Section 27 05 29 - Hangers and Supports for Communications Systems.

1.3 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

E. MFMA-4 - Metal Framing Standards Publication; 2004.

F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.

2. Coordinate work to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.

4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.

5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 03 30 00.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

1.6 QUALITY ASSURANCE

A. Maintain at project site one copy of each referenced document that prescribes execution requirements.

B. Installer Qualifications for Powder-Actuated Fasteners: Certified by fastener system manufacturer with current operator's license.

C. Installer Qualifications for Field Welding: See Section 05 50 00.

D. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 – PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with the following. Where requirements differ, comply with most stringent.

a. NFPA 70.

b. Applicable building code.

c. Requirements of authorities having jurisdiction.

2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.

3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.

4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.

5. Do not use products for applications other than as permitted by NFPA 70 and product listing.

6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.

    a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.

    b. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.

    c. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Components for Vibration Isolation and/or Seismic Controls: See Section 26 05 48.

C. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.

1. Manufacturers:

    a. ABB: www.electrification.us.abb.com/#sle.

    b. Eaton Corporation: www.eaton.com/#sle.

    c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.

    d. Substitutions: See Section 01 60 00 - Product Requirements.

2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.

3. Conduit Clamps: Bolted type unless otherwise indicated.

4. Products:

    a. Gripple, Inc; Universal Clamp (Threaded): www.gripple.com/#sle.

    b. Substitutions: See Section 01 60 00 - Product Requirements.

D. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

1. Manufacturers:

    a. ABB: www.electrification.us.abb.com/#sle.

    b. Eaton Corporation: www.eaton.com/#sle.

    c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.

    d. Substitutions: See Section 01 60 00 - Product Requirements.

E. Metal Channel/Strut Framing Systems:

1. Manufacturers:

a. ABB: www.electrification.us.abb.com/#sle.

b. Atkore International Inc; Unistrut: www.unistrut.us/#sle.

c. Eaton Corporation: www.eaton.com/#sle.

d. Substitutions: See Section 01 60 00 - Product Requirements.

e. Source Limitations: Furnish channel/strut and associated fittings, accessories, and hardware produced by single manufacturer.

2. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.

3. Comply with MFMA-4.

4. Channel Material:

a. Indoor Dry Locations: Use galvanized steel.

b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.

5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm).

6. Minimum Channel Dimensions: 1-5/8 inch (41 mm) wide by 13/16 inch (21 mm) high.

F. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

1. Minimum Size, Unless Otherwise Indicated or Required:

a. Equipment Supports: 1/2-inch (13 mm) diameter.

b. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch (6 mm) diameter.

c. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch (10 mm) diameter.

d. Trapeze Support for Multiple Conduits: 3/8-inch (10 mm) diameter.

e. Outlet Boxes: 1/4-inch (6 mm) diameter.

f. Luminaires: 1/4-inch (6 mm) diameter.

G. Nonpenetrating Rooftop Supports for Low-Slope Roofs:

1. Manufacturers:

a. Atkore International Inc; Unistrut: www.unistrut.us/#sle.

b. Eaton Corporation: www.eaton.com/#sle.

c. Substitutions: See Section 01 60 00 - Product Requirements.

2. Description: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.

3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.

4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

5. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.

H. Anchors and Fasteners:

1. Manufacturers - Mechanical Anchors:

a. Dewalt: anchors.dewalt.com/#sle.

b. Hilti, Inc: www.hilti.com/#sle.

c. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.

d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.

e. Substitutions: See Section 01 60 00 - Product Requirements.

2. Manufacturers - Powder-Actuated Fastening Systems:

a. Dewalt: anchors.dewalt.com/#sle.

b. Hilti, Inc: www.hilti.com/#sle.

c. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.

d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.

e. Substitutions: See Section 01 60 00 - Product Requirements.

3. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.

4. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.

5. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.

6. Hollow Masonry: Use toggle bolts.

7. Hollow Stud Walls: Use toggle bolts.

8. Steel: Use beam clamps, machine bolts, or welded threaded studs.

9. Sheet Metal: Use sheet metal screws.

10. Wood: Use wood screws.

11. Plastic and lead anchors are not permitted.

12. Powder-actuated fasteners are permitted.

    a. Where approved by Architect.

13. Hammer-driven anchors and fasteners are not permitted.

14. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.

    a. Manufacturer: Same as manufacturer of metal channel/strut framing system.

    b. Comply with MFMA-4.

    c. Channel Material: Use galvanized steel.

    d. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm) minimum base metal thickness.

15. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install hangers and supports in accordance with NECA 1.

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

H. Provide required vibration isolation and/or seismic controls; see Section 26 05 48.

I. Equipment Support and Attachment:

1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.

2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

4. Unless otherwise indicated, mount floor-mounted equipment on properly sized concrete pad 3 inches (80 mm) in height; see Section 03 30 00.

5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

J. Conduit Support and Attachment: See Section 26 05 33.13 for additional requirements.

K. Box Support and Attachment: See Section 26 05 33.16 for additional requirements.

L. Interior Luminaire Support and Attachment: See Section 26 51 00 for additional requirements.

M. Exterior Luminaire Support and Attachment: See Section 26 56 00 for additional requirements.

N. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

O. Secure fasteners in accordance with manufacturer's recommended torque settings.

P. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 05 29

SECTION 26 05 33.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. Stainless steel rigid metal conduit (RMC).

C. Galvanized steel intermediate metal conduit (IMC).

D. Stainless steel intermediate metal conduit (IMC).

E. PVC-coated galvanized steel rigid metal conduit (RMC).

F. Flexible metal conduit (FMC).

G. Liquidtight flexible metal conduit (LFMC).

H. Galvanized steel electrical metallic tubing (EMT).

I. Rigid polyvinyl chloride (PVC) conduit.

J. Liquidtight flexible nonmetallic conduit (LFNC).

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete encasement of conduits.

B. Section 07 84 00 - Firestopping.

C. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Cable assemblies consisting of conductors protected by integral metal armor.

D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

E. Section 26 05 29 - Hangers and Supports for Electrical Systems.

F. Section 26 05 33.16 - Boxes for Electrical Systems.

G. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing – Steel (EMT-S); 2020.

C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.

F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.

G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

H. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.

I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.

J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.

M. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

N. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.

O. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.

P. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

Q. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

R. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

S. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

T. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.

2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.

3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.

4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.

5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

C. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2-inch (53 mm) trade size and larger.

1.6 QUALITY ASSURANCE

A. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions and shop drawings.

B. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 – PRODUCTS

2.1 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:

1. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or schedule 80 rigid PVC conduit where emerging from underground.

2. Where rigid polyvinyl (PVC) conduit larger than 2-inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit (RMC) elbows, stainless steel rigid metal conduit (RMC) elbows, galvanized steel intermediate metal conduit (IMC) elbows, stainless steel intermediate metal conduit (IMC) elbows, PVC-coated galvanized steel rigid metal conduit (RMC) elbows, or concrete-encased PVC elbows for bends.

3. Where galvanized rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) emerges from concrete into soil, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches (100 mm) on either side of where conduit emerges.

D. Embedded Within Concrete:

1. Within Slab on Grade: Not permitted.

2. Within Slab Above Ground: Not permitted.

3. Within Concrete Walls Above Ground: Use rigid PVC conduit.

2.2 CONDUIT - GENERAL REQUIREMENTS

A. Comply with NFPA 70.

B. Provide conduit, fittings, supports, and accessories required for complete raceway system.

C. Provide products listed, classified, and labeled as suitable for purpose intended.

D. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.

2. Material: Use steel or malleable iron.

3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.4 STAINLESS STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC stainless steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6A.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6A.

2. Material: Use stainless steel with corrosion resistance equivalent to conduit.

3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.5 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.

2. Material: Use steel or malleable iron.

3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.6 STAINLESS STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.

2.7 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch (1.02 mm).

C. PVC-Coated Boxes and Fittings:

1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.

2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.

3. Material: Use steel or malleable iron.

4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch (1.02 mm).

D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch (0.38 mm).

2.8 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

B. Fittings:

1. Manufacturer: Same as manufacturer of conduit to be connected.

2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in accordance with NECA 1.

C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.

D. Intermediate Metal Conduit (IMC): Install in accordance with NECA 101.

E. PVC-Coated Galvanized Steel Rigid Metal Conduit (RMC): Install using only tools approved by manufacturer.

F. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.

G. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 05 29.

2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

H. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.

2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.

3. Use suitable adapters where required to transition from one type of conduit to another.

4. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.

5. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.

6. Secure joints and connections to provide mechanical strength and electrical continuity.

I. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.

2. Make penetrations perpendicular to surfaces unless otherwise indicated.

3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.

4. Conceal bends for conduit risers emerging above ground.

5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.

6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.

7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 84 00.

J. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide minimum concrete cover of 3 inches (76 mm) on all sides unless otherwise indicated; see Section 03 30 00.

K. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:

1. Where conduits cross structural joints intended for expansion, contraction, or deflection.

2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.

3. Where conduits are subject to earth movement by settlement or frost.

L. Conduit Sealing:

1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:

a. Where conduits enter building from outside.

b. Where service conduits enter building from underground distribution system.

c. Where conduits enter building from underground.

d. Where conduits may transport moisture to contact live parts.

2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:

a. Where conduits pass from outdoors into conditioned interior spaces.

b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

M. Provide grounding and bonding; see Section 26 05 26.

END OF SECTION 26 05 33.13

SECTION 26 05 33.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).

C. Boxes and enclosures for integrated power, data, and audio/video.

D. Boxes for hazardous (classified) locations.

E. Floor boxes.

F. Underground boxes/enclosures.

G. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 08 31 00 - Access Doors and Panels: Panels for maintaining access to concealed boxes.

C. Section 26 05 29 - Hangers and Supports for Electrical Systems.

D. Section 26 05 33.13 - Conduit for Electrical Systems:

1. Conduit bodies and other fittings.

2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 27 26 - Wiring Devices:

1. Wall plates.

2. Floor box service fittings.

3. Poke-through assemblies.

4. Access floor boxes.

5. Additional requirements for locating boxes for wiring devices.

G. Section 27 10 00 - Structured Cabling: Additional requirements for communications systems outlet boxes.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. SCTE 77 - Specifications for Underground Enclosure Integrity; 2023.

H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

J. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.

K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

L. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

PART 2 – PRODUCTS

2.1 BOXES

A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.

2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.

3. Provide products listed, classified, and labeled as suitable for the purpose intended.

4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.

2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.

3. Use suitable concrete type boxes where flush-mounted in concrete.

4. Use suitable masonry type boxes where flush-mounted in masonry walls.

5. Use raised covers suitable for the type of wall construction and device configuration where required.

6. Use shallow boxes where required by the type of wall construction.

7. Do not use "through-wall" boxes designed for access from both sides of wall.

8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.

9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.

10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.

11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.

12. Wall Plates: Comply with Section 26 27 26.

13. Manufacturers:

    a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.

    b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.

    c. Thomas & Betts Corporation: www.tnb.com/#sle.

    d. Substitutions: See Section 01 60 00 - Product Requirements.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):

1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.

2. NEMA 250 Environment Type, Unless Otherwise Indicated:

3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):

    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

4. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.

5. Manufacturers:

    a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.

    b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.

    c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.

    d. Substitutions: See Section 01 60 00 - Product Requirements.

D. Boxes and Enclosures for Integrated Power, Data, and Audio/Video: Size and configuration as indicated or as required with partitions to separate services; field-connected gangable boxes may be used.

1. Manufacturers:

    a. Hubbell Incorporated: www.hubbell.com/#sle.

    b. Substitutions: See Section 01 60 00 - Product Requirements.

E. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.

1. Manufacturers:

a. Appleton, a brand of Emerson Electric Co: www.emerson.com/#sle.

b. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.

c. Hubbell Incorporated; Killark Products: www.hubbell-killark.com/#sle.

d. Substitutions: See Section 01 60 00 - Product Requirements.

F. Underground Boxes/Enclosures:

1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.

2. Size: As indicated on drawings.

3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches (300 mm).

4. Applications:

a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.

b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.

c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.

5. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.

a. Manufacturers:

1) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com/#sle.

2) Oldcastle Precast, Inc: www.oldcastleprecast.com/#sle.

3) Substitutions: See Section 01 60 00 - Product Requirements.

b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

2.2 ACCESSORIES

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for boxes and facade materials to be installed.

1. Manufacturers:

a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.

b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Box Locations:

1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.

2. Unless dimensioned, box locations indicated are approximate.

3. Locate boxes as required for devices installed under other sections or by others.

    a. Communications Systems Outlets: Comply with Section 27 10 00.

4. Locate boxes so that wall plates do not span different building finishes.

5. Locate boxes so that wall plates do not cross masonry joints.

6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.

7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches (150 mm) horizontal separation unless otherwise indicated.

8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) horizontal separation.

9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.

    a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.

10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13.

11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:

    a. Concealed above accessible suspended ceilings.

    b. Within joists in areas with no ceiling.

    c. Electrical rooms.

    d. Mechanical equipment rooms.

H. Box Supports:

1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.

2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.

I. Install boxes plumb and level.

J. Flush-Mounted Boxes:

1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) or does not project beyond finished surface.

2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.

3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.

K. Floor-Mounted Cabinets: Mount on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 30 00.

L. Install boxes as required to preserve insulation integrity.

M. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

N. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.

O. Underground Boxes/Enclosures:

1. Install enclosure on gravel base, minimum 6 inches (150 mm) deep.

2. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

P. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

R. Close unused box openings.

S. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

T. Provide grounding and bonding in accordance with Section 26 05 26.

U. Identify boxes in accordance with Section 26 05 53.

3.3 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 26 05 33.16

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Underground warning tape.

F. Floor marking tape.

G. Warning signs and labels.

1.2 RELATED REQUIREMENTS

A. Section 09 91 13 - Exterior Painting.

B. Section 09 91 23 - Interior Painting.

C. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

D. Section 26 23 00 - Low-Voltage Switchgear: Factory-installed mimic bus.

E. Section 26 27 26 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.

F. Section 27 10 00 - Structured Cabling: Identification for communications cabling and devices.

1.3 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2023.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.

E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:

1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.

2. Do not install identification products until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.7 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 – PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.

a. Panelboards:

1) Identify ampere rating.

2) Identify voltage and phase.

3) Identify power source and circuit number. Include location when not within sight of equipment.

4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.

5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.

6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

b. Enclosed switches, circuit breakers, and motor controllers:

1) Identify voltage and phase.

2) Identify power source and circuit number. Include location when not within sight of equipment.

3) Identify load(s) served. Include location when not within sight of equipment.

c. Time Switches:

1) Identify load(s) served and associated circuits controlled. Include location.

d. Transfer Switches:

1) Identify voltage and phase.

2) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.

3) Identify load(s) served. Include location when not within sight of equipment.

4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.

e. Electricity Meters:

1) Identify load(s) metered.

2. Service Equipment:

a. Use identification nameplate to identify each service disconnecting means.

3. Emergency System Equipment:

a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.

b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.

c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.

4. Use voltage marker to identify highest voltage present for each piece of electrical equipment.

5. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.

6. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.

7. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".

8. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.

a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches (76 mm) wide, painted in accordance with Section 09 91 23 and 09 91 13.

9. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.

a. Service equipment.

b. Industrial control panels.

c. Motor control centers.

d. Elevator control panels.

e. Industrial machinery.

10. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.

    a. Minimum Size: 3.5 by 5 inches (89 mm by 127 mm).

    b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.

    c. Service Equipment: Include the following information in accordance with NFPA 70.

        1) Nominal system voltage.

        2) Available fault current.

        3) Date label applied.

11. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.

12. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".

B. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.

2. Identification for Communications Conductors and Cables: Comply with Section 27 10 00.

3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:

   a. At each source and load connection.

   b. Within boxes when more than one circuit is present.

   c. Within equipment enclosures when conductors and cables enter or leave the enclosure.

5. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.

C. Identification for Raceways:

1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet (6.1 m).

2. Use voltage markers, color-coded bands, or factory-painted conduits to identify systems other than normal power system for accessible conduits.

   a. Maximum Intervals: 20 feet (6.1 m).

   b. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches (76 mm) wide.

      1) Field-Painting: Comply with Section 09 91 23 and 09 91 13.

      2) Vinyl Color Coding Electrical Tape: Comply with Section 26 05 19.

   c. Color Code:

      1) Emergency Power System: Red.

      2) Fire Alarm System: Red.

3. Use identification labels or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.

4. Use identification labels or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.

5. Use underground warning tape to identify underground raceways.

6. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet (6.1 m).

D. Identification for Boxes:

1. Use voltage markers to identify highest voltage present.

2. Use voltage markers or color coded boxes to identify systems other than normal power system.

a. Color-Coded Boxes: Field-painted in accordance with Section 09 91 23 and 09 91 13 per the same color code used for raceways.

1) Emergency Power System: Red.

2) Fire Alarm System: Red.

b. For exposed boxes in public areas, do not color code.

3. Use identification labels to identify circuits enclosed.

a. For exposed boxes in public areas, use only identification labels.

E. Identification for Devices:

1. Identification for Communications Devices: Comply with Section 27 10 00.

2. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.

3. Factory Pre-Marked Wallplates: Comply with Section 26 27 26.

4. Use identification label to identify fire alarm system devices.

a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.

5. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.

6. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.

7. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

F. Identification for Luminaires:

1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Manufacturers:

a. Seton Identification Products: www.seton.com/#sle.

b. Substitutions: See Section 01 60 00 - Product Requirements.

2. Materials:

a. Indoor Clean, Dry Locations: Use plastic nameplates.

b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.

3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.

a. Exception: Provide minimum thickness of 1/8 inch (3 mm) when any dimension is greater than 4 inches (100 mm).

4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.

5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.

6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Manufacturers:

a. Brady Corporation: www.bradyid.com/#sle.

b. Panduit Corp: www.panduit.com/#sle.

c. Substitutions: See Section 01 60 00 - Product Requirements.

2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.

3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).

2. Legend:

a. System designation where applicable:

1) Emergency Power System: Identify with text "EMERGENCY".

2) Fire Alarm System: Identify with text "FIRE ALARM".

b. Equipment designation or other approved description.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height:

a. System Designation: 1 inch (25 mm).

b. Equipment Designation: 1/2 inch (13 mm).

c. Other Information: 1/4 inch (6 mm).

d. Exception: Provide minimum text height of 1 inch (25 mm) for equipment located more than 10 feet (3.0 m) above floor or working platform.

5. Color:

a. Normal Power System: White text on black background.

1) 208Y/120 V, 3 Phase Equipment: White text on background.

b. Emergency Power System: White text on red background.

c. Fire Alarm System: White text on red background.

D. Format for General Information and Operating Instructions:

1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).

2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height: 1/4 inch (6 mm).

5. Color: Black text on white background unless otherwise indicated.

   a. Exceptions:

      1) Provide white text on red background for general information or operational instructions for emergency systems.

      2) Provide white text on red background for general information or operational instructions for fire alarm systems.

E. Format for Caution and Warning Messages:

1. Minimum Size: 2 inches (51 mm) by 4 inches (100 mm).

2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height: 1/2 inch (13 mm).

5. Color: Black text on yellow background unless otherwise indicated.

F. Format for Receptacle Identification:

1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).

2. Legend: Power source and circuit number or other designation indicated.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height: 3/16 inch (5 mm).

5. Color: Black text on clear background.

G. Format for Control Device Identification:

1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).

2. Legend: Load controlled or other designation indicated.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height: 3/16 inch (5 mm).

5. Color: Black text on clear background.

H. Format for Fire Alarm Device Identification:

1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).

2. Legend: Designation indicated and device zone or address.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height: 3/16 inch (5 mm).

5. Color: Red text on white background.

2.3 WIRE AND CABLE MARKERS

A. Manufacturers:

1. Brady Corporation: www.bradyid.com/#sle.

2. Panduit Corp: www.panduit.com/#sle.

3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

1. Do not use handwritten text.

F. Minimum Text Height: 1/8 inch (3 mm).

G. Color: Black text on white background unless otherwise indicated.

2.4 VOLTAGE MARKERS

A. Manufacturers:

1. Brady Corporation: www.bradyid.com/#sle.

2. Seton Identification Products: www.seton.com/#sle.

3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

D. Minimum Size:

1. Markers for Equipment: 1 1/8 by 4 1/2 inches (29 by 110 mm).

2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.

3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches (29 by 110 mm).

4. Markers for Junction Boxes: 1/2 by 2 1/4 inches (13 by 57 mm).

E. Legend:

1. Markers for Voltage Identification: Highest voltage present.

2. Markers for System Identification:

a. Emergency Power System: Text "EMERGENCY".

F. Color: Black text on orange background unless otherwise indicated.

2.5 UNDERGROUND WARNING TAPE

A. Manufacturers:

1. Brady Corporation: www.bradyid.com/#sle.

2. Seton Identification Products: www.seton.com/#sle.

3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Materials: Use polyethylene tape suitable for direct burial, unless otherwise indicated.

C. Non-detectable Type Tape: 6 inches (152 mm) wide, with minimum thickness of 4 mil (0.1 mm).

D. Foil-backed Detectable Type Tape: 3 inches (76 mm) wide, with minimum thickness of 5 mil (0.1 mm), unless otherwise required for proper detection.

E. Legend: Type of service, continuously repeated over full length of tape.

F. Color:

1. Tape for Buried Power Lines: Black text on red background.

2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.6 FLOOR MARKING TAPE

A. Manufacturers:

1. Brady Corporation: www.bradyid.com/#sle.

2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches (76 mm) wide, with alternating black and white stripes.

2.7 WARNING SIGNS AND LABELS

A. Manufacturers:

1. Clarion Safety Systems, LLC: www.clarionsafety.com/#sle.

2. Seton Identification Products: www.seton.com/#sle.

3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:

1. Materials:

a. Outdoor Locations: Use factory pre-printed rigid aluminum signs.

2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.

3. Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated.

D. Warning Labels:

1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.

    a. Do not use labels designed to be completed using handwritten text.

2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.

3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

E. Floor Signs:

1. Materials: Use factory preprinted, self-adhesive vinyl, polyester, or rubber labels with protective overlaminate; removable.

PART 3 – EXECUTION

3.1 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:

1. Surface-Mounted Equipment: Enclosure front.

2. Flush-Mounted Equipment: Inside of equipment door.

3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.

4. Elevated Equipment: Legible from the floor or working platform.

5. Branch Devices: Adjacent to device.

6. Interior Components: Legible from the point of access.

7. Conduits: Legible from the floor.

8. Boxes: Outside face of cover.

9. Conductors and Cables: Legible from the point of access.

10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

1. Do not use adhesives on exterior surfaces except where substrate cannot be penetrated.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches (75 mm) below finished grade.

G. Secure rigid signs using stainless steel screws.

H. Mark all handwritten text, where permitted, to be neat and legible.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 26 05 53

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Occupancy sensors.

B. Outdoor motion sensors.

C. Time switches.

D. In-wall time switches.

E. In-wall interval timers.

F. Outdoor photo controls.

G. Daylighting controls.

H. Lighting contactors.

I. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 29 - Hangers and Supports for Electrical Systems

C. Section 26 05 33.16 - Boxes for Electrical Systems.

D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 27 26 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.

1. Includes finish requirements for wall controls specified in this section.

2. Includes accessory receptacles, switches, dimmers and wall plates, to match lighting controls specified in this section.

F. Section 26 28 13 - Fuses.

G. Section 26 51 00 - Interior Lighting.

H. Section 26 56 00 - Exterior Lighting.

1.3 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.

B. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols; 2020.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

F. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.

G. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

H. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; 2017.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

K. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.

L. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

M. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.

2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.

3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.

4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.

5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install lighting control devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.

1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

C. Field Quality Control Reports.

D. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Operation and Maintenance Data: Include detailed information on device programming and setup.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Electronic Trip Circuit Breakers: Provide one portable test set.

3. Indicating Lights: Two of each different type.

G. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for all occupancy sensors.

C. Provide two year manufacturer warranty for all daylighting controls.

PART 2 – PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.2 OCCUPANCY SENSORS

A. Manufacturers:

1. Acuity Brands, Inc: www.acuitybrands.com/#sle.

2. Hubbell Incorporated: www.hubbell.com/#sle.

3. Intermatic, Inc: www.intermatic.com/#sle.

4. Legrand North America, Inc: www.legrand.us/#sle.

5. Lutron Electronics Company, Inc: www.lutron.com/#sle.

6. RAB Lighting, Inc: www.rablighting.com/#sle.

7. Substitutions: See Section 01 60 00 - Product Requirements.

8. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. All Occupancy Sensors:

1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.

2. Sensor Technology:

   a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.

3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.

4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.

5. Sensitivity: Field adjustable.

6. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.

7. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.

8. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.

9. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.

10. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.

11. Wireless Sensors:

    a. RF Range: 30 feet (9 m) through typical construction materials.

    b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.

    c. Power: Battery-operated with minimum ten-year battery life.

C. Wall Switch Occupancy Sensors:

1. All Wall Switch Occupancy Sensors:

    a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.

    b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.

    c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.

    d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).

    e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.

    f. Provide selectable audible alert to notify occupant of impending load turn-off.

    g. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.

    h. Provide vandal resistant lenses for passive infrared (PIR) and dual technology wall switch occupancy sensors where indicated.

2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).

    a. Products:

        1) Substitutions: See Section 01 60 00 - Product Requirements.

D. Wall Dimmer Occupancy Sensors:

1. General Requirements:

    a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability , and no leakage current to load in off mode.

    b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).

    c. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.

    d. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.

    e. Provide field adjustable dimming preset for occupied state.

    f. Provide fade-to-off operation to notify occupant of impending load turn-off.

    g. Finish: Color to be selected by Architect.

E. Ceiling Mounted Occupancy Sensors:

1. All Ceiling Mounted Occupancy Sensors:

    a. Description: Low profile occupancy sensors designed for ceiling installation.

    b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.

    c. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.

    d. Finish: White unless otherwise indicated.

2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:

a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.

1) Products:

(a) Substitutions: See Section 01 60 00 - Product Requirements.

b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet (111.5 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.

1) Products:

(a) Substitutions: See Section 01 60 00 - Product Requirements.

F. Power Packs for Low Voltage Occupancy Sensors:

1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.

2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.

3. Input Supply Voltage: Dual rated for 120/277 V ac.

4. Load Rating: As required to control the load indicated on drawings.

G. Power Packs for Wireless Occupancy Sensors:

1. Input Supply Voltage: Dual rated for 120/277 V ac.

2.3 OUTDOOR MOTION SENSORS

A. Manufacturers:

1. Acuity Brands, Inc: www.acuitybrands.com/#sle.

2. Hubbell Lighting, Inc: www.hubbelllighting.com/#sle.

3. Legrand North America, Inc: www.legrand.us/#sle.

4. RAB Lighting, Inc: www.rablighting.com/#sle.

5. Substitutions: See Section 01 60 00 - Product Requirements.

6. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. Description: Factory-assembled wet location listed device suitable for wall or ceiling/eave mounting, with integral swivel for field adjustment of coverage, capable of detecting motion for automatic control of load indicated.

C. Sensor Technology: Passive Infrared (PIR) designed to detect occupancy by sensing movement of thermal energy between zones.

D. Operation: Unless otherwise indicated, motion sensor to turn load on when motion is detected and to turn load off when no motion is detected during an adjustable turn-off delay time interval.

E. Turn-Off Delay: Field adjustable, with time delay settings available up to 15 minutes.

F. Integral Photocell: For dusk to dawn operation.

G. Manual Override: Activated by switching power off to unit and then back on.

H. Load Rating: 1,000 W incandescent and fluorescent load at 120 V ac.

I. Coverage: Capable of detecting motion within a distance of 50 feet (15 m) at a mounting height of 8 feet (2.4 m), with a field of view of 270 degrees.

J. Finish: Color to be selected.

2.4 TIME SWITCHES

A. Manufacturers:

1. Intermatic, Inc: www.intermatic.com/#sle.

2. NSI Industries LLC: www.nsiindustries.com/#sle.

3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Digital Electronic Time Switches:

1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.

2. Program Capability:

a. 24-Hour Time Switches: Single channel, with same schedule for each day of the week and skip-a-day feature to omit selected days.

b. 7-Day Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days.

c. Astronomic Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.

3. Schedule Capacity: Not less than 16 programmable on/off operations.

4. Provide automatic daylight savings time and leap year compensation.

5. Provide power outage backup to retain programming and maintain clock.

6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.

7. Provide remote photocell input with light level adjustment.

8. Input Supply Voltage: As indicated on the drawings.

9. Output Switch Configuration: As required to control the load indicated on drawings.

10. Output Switch Configuration: SPST dry unpowered maintained contacts.

11. Output Switch Contact Ratings: As required to control the load indicated on drawings.

12. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:

a. Indoor clean, dry locations: Type 1.

b. Outdoor locations: Type 3R.

2.5 IN-WALL INTERVAL TIMERS

A. Manufacturers:

1. Intermatic, Inc: www.intermatic.com/#sle.

2. NSI Industries LLC: www.nsiindustries.com/#sle.

3. Substitutions: See Section 01 60 00 - Product Requirements.

4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. Digital Electronic In-Wall Interval Timers:

1. Description: Factory-assembled solid state programmable controller with LCD display, suitable for mounting in standard wall box, and listed and labeled as complying with UL 916 or UL 917.

2. Program Capability: Designed to turn load off at end of preset time interval.

3. Time Interval: Field selectable range of presets available up to 12 hours.

4. Provide field selectable audible and visual indication to warn that end of interval operation is about to turn off load.

5. Provide power outage backup to retain programming and maintain clock.

6. Manual override: Capable of both turning load off and resetting timer to original preset time interval.

7. Switch Configuration: Suitable for use in either SPST or 3-way application.

8. Contact Ratings: As required to control the load indicated on drawings.

2.6 OUTDOOR PHOTO CONTROLS

A. Manufacturers:

1. Intermatic, Inc: www.intermatic.com/#sle.

2. Substitutions: See Section 01 60 00 - Product Requirements.

3. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. Stem-Mounted Outdoor Photo Controls:

1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.

2. Housing: Weatherproof, impact resistant polycarbonate.

3. Photo Sensor: Cadmium sulfide.

4. Provide external sliding shield for field adjustment of light level activation.

5. Light Level Activation: 1 to 5 footcandles (10.8 to 53.8 lux) turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.

6. Voltage: As required to control the load indicated on the drawings.

7. Failure Mode: Fails to the on position.

8. Load Rating: As required to control the load indicated on the drawings.

9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

2.7 DAYLIGHTING CONTROLS

A. Manufacturers:

1. Hubbell Control Solutions:
www.hubbell.com/hubbellcontrolsolutions/en/#sle.Hubbell Control Solutions:
www.hubbell.com/hubbellcontrolsolutions/en/#sle.Hubbell Control Solutions;
_____: www.hubbell.com/hubbellcontrolsolutions/en/#sle.

2. Lutron Electronics Company, Inc: www.lutron.com/#sle.

3. Sensor Switch Inc: www.sensorswitch.com/#sle.

4. WattStopper: www.wattstopper.com/#sle.

5. Substitutions: See Section 01 60 00 - Product Requirements.

6. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.

C. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.

1. Sensor Type: Filtered silicon photo diode.

2. Sensor Range:

a. Indoor Photo Sensors: 5 to 100 footcandles (53.8 to 1,080 lx).

3. Finish: White unless otherwise indicated.

4. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.

D. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.

E. Daylighting Control Switching Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors, for switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.

1. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.

2. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.

3. Control Capability:

a. Single Zone Switching Modules: Capable of controlling one programmable channel.

b. Multi-Zone Switching Modules: Capable of controlling up to three separately programmable channels.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of lighting control devices provided under this section.

1. Mounting Heights: Unless otherwise indicated, as follows:

a. In-Wall Interval Timers: 48 inches (1.2 m) above finished floor.

2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.

3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

C. Install lighting control devices in accordance with manufacturer's instructions.

D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E. Install lighting control devices plumb and level, and held securely in place.

F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 27 26.

G. Provide required supports in accordance with Section 26 05 29.

H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

I. Identify lighting control devices in accordance with Section 26 05 53.

J. Occupancy Sensor Locations:

1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect.

K. Outdoor Photo Control Locations:

1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.

2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.

L. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.

M. Daylighting Control Photo Sensor Locations:

1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect each lighting control device for damage and defects.

C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

D. Test time switches to verify proper operation.

E. Test outdoor photo controls to verify proper operation, including time delays where applicable.

F. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.

G. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.5 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.

D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.

F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.

3.6 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 COMMISSIONING

A. See Section 01 91 13 - General Commissioning Requirements for commissioning requirements.

3.8 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

B. See Section 01 79 00 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of two hours of training.

3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.

4. Location: At project site.

END OF SECTION 26 09 23

SECTION 26 21 00
LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Electrical service requirements.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Materials and installation requirements for cast-in-place concrete equipment pads.

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

D. Section 26 05 29 - Hangers and Supports for Electrical Systems.

E. Section 26 05 33.13 - Conduit for Electrical Systems.

F. Section 26 05 33.23 - Surface Raceways for Electrical Systems: Wireways.

G. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

H. Section 26 24 16 - Panelboards: Service entrance equipment.

I. Section 26 28 16.16 - Enclosed Switches: Service entrance equipment.

J. Section 26 32 13 - Engine Generators: Emergency/standby power systems for interconnection with normal utility electrical supply.

K. Section 26 36 00 - Transfer Switches: Service entrance equipment.

L. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

1.3 DEFINITIONS

A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.4 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 ADMINISTRATIVE REQUIREMENTS

A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.

B. Coordination:

1. Verify the following with Utility Company representative:

a. Utility Company requirements, including division of responsibility.

b. Exact location and details of utility point of connection.

c. Utility easement requirements.

d. Utility Company charges associated with providing service.

2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.

3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Coordinate the work with other installers to provide communication lines required for Utility Company meters.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.

D. Utility Company charges associated with providing permanent service to be paid by Owner.

E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.

F. Scheduling:

1. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations and arrangement of Utility Company and service entrance equipment, metering provisions, required clearances, and proposed service routing.

1. Obtain Utility company approval of shop drawings prior to submittal.

D. Drawings prepared by Utility Company.

E. Project Record Documents: Record actual locations of equipment and installed service routing.

1.7 QUALITY ASSURANCE

A. Comply with the following:

1. IEEE C2 (National Electrical Safety Code).

2. NFPA 70 (National Electrical Code).

3. The requirements of the Utility Company.

4. The requirements of the local authorities having jurisdiction.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 – PRODUCTS

2.1 ELECTRICAL SERVICE REQUIREMENTS

A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.

B. Electrical Service Characteristics: As indicated on drawings.

C. Utility Company: As indicated on drawings.

D. Division of Responsibility:

1. Pad-Mounted Utility Transformers:

a. Transformer Vaults and Pads: Furnished and installed by Contractor per Utility Company requirements.

b. Transformers: Furnished and installed by Utility Company.

c. Transformer Grounding Provisions: Furnished and installed by Contractor per Utility Company requirements.

d. Transformer Protective Bollards: Furnished and installed by Contractor per Utility Company requirements.

e. Primary:

1) Trenching and Backfilling: Provided by Contractor.

2) Conduits: Furnished and installed by Contractor.

3) Conductors: Furnished and installed by Utility Company.

f. Secondary:

1) Trenching and Backfilling: Provided by Contractor.

2) Conduits: Furnished and installed by Contractor.

3) Conductors: Furnished and installed by Contractor (Service Point at transformer).

2. Terminations at Service Point: Provided by Utility Company.

3. Metering Provisions:

a. Meter Bases: Furnished and installed by Contractor per Utility Company requirements.

b. Metering Transformer Cabinets: Furnished and installed by Contractor per Utility Company requirements.

c. Metering Compartments in Service Entrance Equipment: Furnished and installed by Contractor per Utility Company requirements.

d. Metering Transformers: Furnished and installed by Utility Company.

e. Conduits Between Metering Transformers and Meters: Furnished and installed by Contractor per Utility Company requirements.

f. Wiring Between Metering Transformers and Meters: Furnished and installed by Utility Company.

E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Verify and mark locations of existing underground utilities.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions and Utility Company requirements.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required trenching and backfilling in accordance with Section 31 23 16.13.

E. Construct cast-in-place concrete pads for utility equipment in accordance with Utility Company requirements and Section 03 30 00.

F. Provide required protective bollards in accordance with Utility Company requirements.

G. Provide required support and attachment components in accordance with Section 26 05 29.

H. Provide grounding and bonding for service entrance equipment in accordance with Section 26 05 26.

I. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 05 53.

3.4 PROTECTION

A. Protect installed equipment from subsequent construction operations.

END OF SECTION 26 21 00

SECTION 26 24 16
PANELBOARDS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Lighting and appliance panelboards.

B. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 29 - Hangers and Supports for Electrical Systems.

C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

E. NEMA PB 1 - Panelboards; 2011.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000 Volts or Less; 2023.

G. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

K. UL 67 - Panelboards; Current Edition, Including All Revisions.

L. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

M. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

N. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

O. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

P. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

Q. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.

4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.

2. Include wiring diagrams showing all factory and field connections.

3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

4. Include documentation of listed series ratings upon request.

D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.

E. Field Quality Control Test Reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Panelboard Keys: Two of each different key.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:

1. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. ABB: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric: www.se.com/#sle.

D. Siemens Industry, Inc: www.new.siemens.com/#sle.

E. Substitutions: See Section 01 60 00 - Product Requirements.

F. Source Limitations: Provide panelboards and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from a single supplier.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet (2,000 m).

2. Ambient Temperature:

a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

C. Short Circuit Current Rating:

1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

2. Label equipment utilizing series ratings as required by NFPA 70.

D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with UL 67 temperature rise requirements.

1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.

2. Provide 200 percent rated neutral bus and lugs where indicated, where oversized neutral conductors are provided, or where panelboards are fed from K-rated transformers.

3. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

4. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

a. Indoor Clean, Dry Locations: Type 1.

b. Outdoor Locations: Type 3R.

2. Boxes: Galvanized steel unless otherwise indicated.

a. Provide wiring gutters sized to accommodate the conductors to be installed.

b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.

c. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.

3. Fronts:

a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.

b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.

c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.

4. Lockable Doors: All locks keyed alike unless otherwise indicated.

J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.

1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.

L. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

M. Load centers are not acceptable.

N. Provide the following features and accessories where indicated or where required to complete installation:

1. Feed-through lugs.

2. Sub-feed lugs.

2.3 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:

1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

2. Main and Neutral Lug Type: Mechanical.

C. Bussing:

1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.

2. Phase and Neutral Bus Material: Aluminum.

3. Ground Bus Material: Aluminum.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:

1. Provide surface-mounted or flush-mounted enclosures as indicated.

2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.

3. Provide clear plastic circuit directory holder mounted on inside of door.

2.4 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:

1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.

2. Interrupting Capacity:

a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:

1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.

b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

3. Conductor Terminations:

   a. Provide mechanical lugs unless otherwise indicated.

   b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.

   a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.

5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.

6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

7. Provide the following circuit breaker types where indicated:

   a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.

   b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.

   c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.

8. Provide listed switching duty rated circuit breakers with SWD marking .

9. Provide listed high intensity discharge lighting rated circuit breakers with HID marking .

10. Do not use tandem circuit breakers.

11. Do not use handle ties in lieu of multi-pole circuit breakers.

12. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.

13. Provide the following features and accessories where indicated or where required to complete installation:

a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2.5 SOURCE QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Factory test panelboards according to NEMA PB 1.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 26 05 29.

F. Install panelboards plumb.

G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.

I. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

J. Provide grounding and bonding in accordance with Section 26 05 26.

1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.

2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.

K. Install all field-installed branch devices, components, and accessories.

L. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

M. Set field-adjustable circuit breaker tripping function settings as indicated.

N. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

O. Provide filler plates to cover unused spaces in panelboards.

P. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:

1. Emergency and night lighting circuits.

2. Fire detection and alarm circuits.

3. Communications equipment circuits.

4. Intrusion detection and access control system circuits.

5. Video surveillance system circuits.

Q. Identify panelboards in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1. Tests listed as optional are not required.

D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

E. Test GFCI circuit breakers to verify proper operation.

F. Test AFCI circuit breakers to verify proper operation.

G. Test shunt trips to verify proper operation.

H. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 24 16

SECTION 26 27 26
WIRING DEVICES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Wall switches.

B. Wall dimmers.

C. Fan speed controllers.

D. Receptacles.

E. Wall plates and covers.

F. Floor box service fittings.

G. Poke-through assemblies.

H. Access floor boxes.

1.2 RELATED REQUIREMENTS

A. Section 09 69 00 - Access Flooring.

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.

C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

D. Section 26 05 33.16 - Boxes for Electrical Systems.

E. Section 26 05 33.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.

F. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

G. Section 26 09 23 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.

H. Section 26 27 23 - Indoor Service Poles.

I. Section 26 29 13 - Enclosed Controllers: Manual motor starters and horsepower rated motor-starting switches without overload protection.

1.3 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.

E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).

F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.

K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

L. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.

M. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

N. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

O. UL 1917 - Solid-State Fan Speed Controls; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.

2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.

3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.

4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.

5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.

6. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1. Wall Dimmers: Include derating information for ganged multiple devices.

C. Field Quality Control Test Reports.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Operation and Maintenance Data:

1. Wall Dimmers: Include information on operation and setting of presets.

2. GFCI Receptacles: Include information on status indicators.

F. Project Record Documents: Record actual installed locations of wiring devices.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Extra Keys for Locking Switches: Two of each type.

3. Extra Wall Plates: One of each style, size, and finish.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Products: Listed, classified, and labeled as suitable for the purpose intended.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 – PRODUCTS

2.1 WIRING DEVICES - GENERAL REQUIREMENTS

A. Provide wiring devices suitable for intended use with ratings adequate for load served.

B. Except where explicitly permitted, substitution of combination switch-and-receptacle devices for separate switches and receptacles is not permitted.

C. Wiring Device Applications:

1. Receptacles Installed Outdoors or in Damp or Wet Locations: Use weather-resistant GFCI receptacles with weatherproof covers.

2. Provide GFCI protection for:

a. Receptacles installed within 6 feet (1.8 m) of sinks.

b. Receptacles installed in kitchens.

c. Receptacles serving electric drinking fountains.

3. Single Receptacles Installed on Individual Branch Circuits: Provide receptacle ampere rating equal to branch circuit rating.

4. Flush Floor Service Fittings in Tile Floors: Use tile rings.

5. Flush Floor Service Fittings in Carpeted Floors: Use carpet flanges.

D. Wiring Device Finishes:

1. Provide wiring device finishes as described below, unless otherwise indicated.

2. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.

3. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.

4. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.

5. Wiring Devices Installed in Wet or Damp Locations: White with weatherproof cover.

6. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.

7. Clock Hanger Receptacles: Brown with stainless steel wall plate.

8. Above-Floor Service Fittings: Gray wiring devices with satin aluminum housing.

9. Flush Floor Box Service Fittings: Gray wiring devices with aluminum cover and ring/flange.

10. Flush Poke-Through Service Fittings: Gray wiring devices with aluminum cover and aluminum flange.

11. Access Floor Boxes: Gray wiring devices with gray steel cover with insert to match floor covering.

2.2 WALL SWITCHES

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell.com/#sle.

2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.

3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring with separate ground terminal screw.

C. Standard Wall Switches: Commercial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

D. Lighted Wall Switches: Commercial specification grade, 20 A, 120/277 V with illuminated standard toggle type switch actuator and maintained contacts; illuminated with load off; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

E. Pilot Light Wall Switches: Commercial specification grade, 20 A, 120/277 V with red illuminated standard toggle type switch actuator and maintained contacts; illuminated with load on; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

F. Locking Wall Switches: Commercial specification grade, 20 A, 120/277 V with lever type keyed switch actuator and maintained contacts; switches keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

G. Momentary Contact Wall Switches: Commercial specification grade, 20 A, 120/277 V with toggle type three position switch actuator and momentary contacts; single pole double throw, off with switch actuator in center position.

H. Locking Momentary Contact Wall Switches: Commercial specification grade, 20 A, 120/277 V with lever type keyed three position switch actuator and momentary contacts; switches keyed alike; single pole double throw, off with switch actuator in center position.

2.3 WALL DIMMERS

A. Manufacturers:

1. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.

2. Lutron Electronics Company, Inc; Maestro Series: www.lutron.com/#sle.

3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

C. Control: Slide control type with separate on/off switch.

D. Provide locator light, illuminated with load off.

E. Provide accessory wall switches to match dimmer appearance when installed adjacent to each other.

2.4 FAN SPEED CONTROLLERS

A. Manufacturers:

1. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.

2. Lutron Electronics Company, Inc; Maestro Series: www.lutron.com/#sle.

3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: 120 V AC, solid-state, full-range variable speed, slide control type with separate on/off switch, with integral radio frequency interference filtering, fan noise elimination circuitry, power failure preset memory, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1917.

1. Current Rating: 1.5 A unless otherwise indicated or required to control the load indicated on the drawings.

2.5 RECEPTACLES

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell.com/#sle.

2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.

3. Lutron Electronics Company, Inc; Designer Style: www.lutron.com/#sle.

4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

5. Substitutions: See Section 01 60 00 - Product Requirements.

6. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.

2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:

1. Standard Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.

2. Automatically Controlled Convenience Receptacles: _____20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.

3. Isolated Ground Convenience Receptacles: _____, 20A, 125V, NEMA 5-20R, with ground contacts isolated from mounting strap; isolated ground triangle mark on device face; single or duplex as indicated on the drawings.

4. Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

5. Tamper Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.

6. Tamper Resistant and Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

7. Illuminated Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R; illuminated face or indicator light to indicate power is being supplied to receptacle; single or duplex as indicated on the drawings.

D. GFCI Receptacles:

1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.

   a. Provide test and reset buttons of same color as device.

2. Standard GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.

   a. Products:

      1) Hubbell Incorporated: www.hubbell.com/#sle.

      2) Substitutions: See Section 01 60 00 - Product Requirements.

3. Weather Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

4. Tamper Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.

5. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

E. USB Charging Devices:

1. USB Charging Devices - General Requirements: Listed as complying with UL 1310.

   a. Charging Capacity - Two-Port Devices: 2.1 A, minimum.

2. USB Charging/Tamper Resistant Receptacle Combination Devices: Two-port (Type A) USB charging device and receptacle, commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; rectangular decorator style.

   a. Products:

      1) Hubbell Incorporated: www.hubbell.com/#sle.

      2) Substitutions: See Section 01 60 00 - Product Requirements.

3. USB Charging Noncombination Devices: Four-port (Type A); rectangular decorator style.

    a. Products:

        1) Hubbell Incorporated: www.hubbell.com/#sle.

        2) Substitutions: See Section 01 60 00 - Product Requirements.

F. Surge Protection Receptacles:

1. Surge Protection Receptacles - General Requirements: Listed and labeled as complying with UL 1449, Type 2 or 3.

    a. Energy Dissipation: Not less than 240 J per mode.

    b. Protected Modes: L-N, L-G, N-G.

    c. UL 1449 Voltage Protection Rating (VPR): Not more than 700 V for L-N, L-G modes and 1200 V for N-G mode.

    d. Diagnostics:

        1) Visual Notification: Provide indicator light to report functional status of surge protection.

        2) Audible Notification: Provide switchable audible alarm to report that surge protection is not functional.

2. Standard Surge Protection Receptacles: _____, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.

    a. Products:

        1) Hubbell Incorporated: www.hubbell.com/#sle.

        2) Substitutions: See Section 01 60 00 - Product Requirements.

3. Isolated Ground Surge Protection Receptacles: Commercial grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, with ground contacts isolated from mounting strap.

    a. Products:

        1) Hubbell Incorporated: www.hubbell.com/#sle.

        2) Substitutions: See Section 01 60 00 - Product Requirements.

G. Locking Receptacles: Commerc, configuration as indicated on the drawings.

1. Standard Locking Convenience Receptacles: Single, 20A, 125V, NEMA L5-20R.

H. Clock Hanger Receptacles: Single, 15A, 125V, NEMA 5-15R.

2.6 WALL PLATES AND COVERS

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.

2. Intermatic, Inc: www.intermatic.com/#sle.

3. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.

4. Lutron Electronics Company, Inc: www.lutron.com/#sle.

5. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

6. Substitutions: See Section 01 60 00 - Product Requirements.

7. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. Wall Plates: Comply with UL 514D.

1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.

2. Size: Standard.

3. Screws: Metal with slotted heads finished to match wall plate finish.

4. Provide screwless wallplates with concealed mounting hardware where indicated.

C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

E. Brass Wall Plates: Brushed satin finish, factory-coated to inhibit oxidation.

F. Aluminum Wall Plates: Smooth satin finish, clear anodized, factory-coated to inhibit oxidation.

G. Chrome Wall Plates: Smooth finish, chrome plated steel.

H. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

I. Premarked Wall Plates: Factory labeled as indicated; hot stamped for nylon wall plates and engraved for metal wall plates.

J. Weatherproof Receptacle Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.

K. Weatherproof Receptacle Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

L. Weatherproof Switch Covers for Wet or Damp Locations: Gasketed, metallic, with externally operable actuating means and corrosion-resistant screws; listed as suitable for use in wet locations.

2.7 FLOOR BOX SERVICE FITTINGS

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell.com/#sle.

2. Thomas & Betts Corporation: www.tnb.com/#sle.

3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Service fittings compatible with floor boxes provided under Section 26 05 33.16 with components, adapters, and trims required for complete installation.

C. Above-Floor Service Fittings:

1. Single Service Pedestal Convenience Receptacles:

a. Configuration: One standard convenience duplex receptacle.

2. Single Service Pedestal Furniture Feed:

a. Configuration: One 3/4 inch knockout.

3. Dual Service Pedestal Combination Outlets:

a. Configuration:

1) Power: One standard convenience duplex receptacle.

2) Communications: One 1 inch bushed opening.

b. Provide barrier to separate line and low voltage compartments.

D. Flush Floor Service Fittings:

1. Single Service Flush Convenience Receptacles:

a. Cover: Rectangular.

b. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).

2. Single Service Flush Communications Outlets:

a. Cover: Rectangular.

b. Configuration: _____.

c. Voice and Data Jacks: Provided by others.

3. Single Service Flush Furniture Feed:

a. Cover: Rectangular.

b. Configuration: One 2-1/8 inch by 3/4 inch combination threaded opening(s).

4. Dual Service Flush Combination Outlets:

a. Cover: Rectangular.

b. Configuration:

1) Power: One standard convenience duplex receptacle(s) with duplex flap opening(s).

2) Communications: _____.

3) Voice and Data Jacks: Provided by others.

5. Dual Service Flush Furniture Feed:

a. Cover: Rectangular.

b. Configuration:

1) Power: One 2-1/8 inch by 3/4 inch combination threaded opening(s).

2) Communications: One 2-1/8 inch by 1 inch combination threaded opening(s).

6. Accessories:

a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.

b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

7. Products:

a. Hubbell Incorporated: www.hubbell.com/#sle.

b. Substitutions: See Section 01 60 00 - Product Requirements.

2.8 POKE-THROUGH ASSEMBLIES

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell.com/#sle.

2. Thomas & Betts Corporation: www.tnb.com/#sle.

3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.

C. Above-Floor Service Fittings:

1. Single Service Pedestal Convenience Receptacles:

a. Configuration: One standard convenience duplex receptacle.

2. Single Service Pedestal Communications Outlets:

a. Configuration: One 1 inch bushed opening.

3. Single Service Pedestal Furniture Feed:

a. Configuration: One 3/4 inch knockout.

4. Dual Service Pedestal Combination Outlets:

a. Configuration:

1) Power: One standard convenience duplex receptacle.

2) Communications: One 1 inch bushed opening.

3) Voice and Data Jacks: Provided by others.

b. Provide barrier to separate line and low voltage compartments.

5. Products:

a. Hubbell Incorporated: www.hubbell.com/#sle.

b. Substitutions: See Section 01 60 00 - Product Requirements.

D. Flush Floor Service Fittings:

1. Single Service Flush Convenience Receptacles:

a. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).

2. Single Service Flush Communications Outlets:

a. Configuration: _____.

b. Voice and Data Jacks: Provided by others.

3. Dual Service Flush Combination Outlets:

a. Cover: Hinged door(s).

b. Configuration:

1) Power: One standard convenience duplex receptacle(s).

2) Communications: _____.

3) Voice and Data Jacks: Provided by others.

4. Dual Service Flush Furniture Feed:

a. Configuration:

1) Power: One 3/4 inch threaded opening(s).

2) Communications: Two 1/2 inch threaded opening(s).

5. Accessories:

    a. Closure Plugs: Size and fire rating as required to seal unused core hole and maintain fire rating of floor.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that floor boxes are adjusted properly.

F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

G. Verify that core drilled holes for poke-through assemblies are in proper locations.

H. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of wiring devices provided under this section.

1. Mounting Heights: Unless otherwise indicated, as follows:

    a. Wall Switches: 48 inches (1200 mm) above finished floor.

    b. Wall Dimmers: 48 inches (1200 mm) above finished floor.

c. Fan Speed Controllers: 48 inches (1200 mm) above finished floor.

d. Receptacles: 18 inches (450 mm) above finished floor or 6 inches (150 mm) above counter.

2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.

3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.

4. Locate wall switches on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.

I. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

J. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.

K. Install wiring devices plumb and level with mounting yoke held rigidly in place.

L. Install wall switches with OFF position down.

M. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

N. Do not share neutral conductor on branch circuits utilizing wall dimmers.

O. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

P. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

Q. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

R. Identify wiring devices in accordance with Section 26 05 53.

S. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect each wiring device for damage and defects.

C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

D. Test each receptacle to verify operation and proper polarity.

E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

F. Inspect each surge protection receptacle to verify surge protection is active.

G. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

3.6 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 26 27 26

SECTION 26 28 13
FUSES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Fuses.

B. Spare fuse cabinet.

1.2 RELATED REQUIREMENTS

A. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

B. Section 26 28 16.16 - Enclosed Switches: Fusible switches.

1.3 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.

D. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.

a. Fusible Enclosed Switches: See Section 26 28 16.16.

2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.

3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

1. Spare Fuse Cabinet: Include dimensions.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Extra Fuses: One set(s) of three for each type and size installed.

3. Fuse Pullers: One set(s) compatible with each type and size installed.

4. Spare Fuse Cabinet Keys: Two.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/#sle.

B. Littelfuse, Inc: www.littelfuse.com/#sle.

C. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 APPLICATIONS

A. Service Entrance:

1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.

2.3 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.

1. Class RK1, Time-Delay Fuses:

2. Class RK1, Fast-Acting, Non-Time-Delay Fuses:

2.4 SPARE FUSE CABINET

A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.

B. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that mounting surfaces are ready to receive spare fuse cabinet.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

C. Install spare fuse cabinet where indicated.

D. Identify spare fuse cabinet in accordance with Section 26 05 53.

END OF SECTION 26 28 13

SECTION 26 28 16.16
ENCLOSED SWITCHES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 29 - Hangers and Supports for Electrical Systems.

C. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.

D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 28 13 - Fuses.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.

2. Include wiring diagrams showing all factory and field connections.

3. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Field Quality Control Test Reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

G. Project Record Documents: Record actual locations of enclosed switches.

H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. See Section 26 28 13 for requirements for spare fuses and spare fuse cabinets.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C) during and after installation of enclosed switches.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. ABB: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric: www.se.com/#sle.

D. Siemens Industry, Inc: www.new.siemens.com/#sle.

E. Source Limitations: Provide enclosed switches and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

2.2 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Seismic Qualification: Provide enclosed safety switches suitable for application under the seismic design criteria specified in Section 26 05 48 where required. Include certification of compliance with submittals.

D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet (2,000 m).

2. Ambient Temperature: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).

E. Horsepower Rating: Suitable for connected load.

F. Voltage Rating: Suitable for circuit voltage.

G. Short Circuit Current Rating:

1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

2. Minimum Ratings:

a. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.

H. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

I. Provide with switch blade contact position that is visible when the cover is open.

J. Fuse Clips for Fusible Switches: As required to accept fuses indicated.

1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

K. Conductor Terminations: Suitable for use with the conductors to be installed.

L. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

M. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

N. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

a. Indoor Clean, Dry Locations: Type 1.

b. Outdoor Locations: Type 3R.

2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

O. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

P. Heavy Duty Switches:

1. Comply with NEMA KS 1.

2. Conductor Terminations:

a. Provide mechanical lugs unless otherwise indicated.

b. Provide compression lugs where indicated.

c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

a. Provide means for locking handle in the ON position where indicated.

Q. Provide the following features and accessories where indicated or where required to complete installation:

1. Hubs: As required for environment type; sized to accept conduits to be installed.

2. Integral fuse pullers.

3. Viewing Window: Positioned over switch blades for visual confirmation of contact position with door closed.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 05 29.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 05 26.

H. Provide fuses complying with Section 26 28 13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 28 16.16

SECTION 26 32 13
ENGINE GENERATORS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Packaged engine generator system and associated components and accessories:

1. Engine and engine accessory equipment.

2. Alternator (generator).

3. Generator set control system.

4. Generator set enclosure.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 23 11 13 - Facility Fuel-Oil Piping:

1. Diesel fuel piping.

2. Installation of diesel fuel system day tank specified in this section.

C. Section 23 11 23 - Facility Natural-Gas Piping.

D. Section 23 11 26 - Facility Liquefied-Petroleum Gas Piping.

E. Section 23 31 00 - HVAC Ducts and Casings.

F. Section 23 51 00 - Breechings, Chimneys, and Stacks: Engine exhaust piping.

1. Includes installation of exhaust silencer specified in this section.

G. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

H. Section 26 05 29 - Hangers and Supports for Electrical Systems.

I. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.

1. Includes requirements for the seismic qualification of equipment specified in this section.

J. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

K. Section 26 36 00 - Transfer Switches.

1.3 REFERENCE STANDARDS

A. ASTM D975 - Standard Specification for Diesel Fuel; 2023a.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

C. NECA/EGSA 404 - Standard for Installing Generator Sets; 2014.

D. NEMA MG 1 - Motors and Generators; 2021.

E. NFPA 30 - Flammable and Combustible Liquids Code; 2024.

F. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines; 2021.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 99 - Health Care Facilities Code; 2024.

I. NFPA 110 - Standard for Emergency and Standby Power Systems; 2022.

J. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries; Current Edition, Including All Revisions.

K. UL 2200 - Stationary Engine Generator Assemblies; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.

a. Transfer Switches: See Section 26 36 00.

b. Paralleling Switchgear: See Section _____.

2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.

3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene one week before starting work of this section; require attendance of all affected installers.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.

1. Include generator set sound level test data.

2. Include characteristic trip curves for overcurrent protective devices upon request.

3. Include alternator thermal damage curve upon request.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.

1. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Derating Calculations: Indicate ratings adjusted for applicable service conditions.

F. Fuel Storage Tank Calculations: Indicate maximum running time for generator set configuration provided.

G. Specimen Warranty: Submit sample of manufacturer's warranty.

H. Evidence of qualifications for installer.

I. Evidence of qualifications for maintenance contractor (if different entity from installer).

J. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

K. Manufacturer's factory emissions certification.

L. Manufacturer's certification that products meet or exceed specified requirements.

M. Source quality control test reports.

N. Provide NFPA 110 required documentation from manufacturer where requested by authorities having jurisdiction, including but not limited to:

1. Certified prototype tests.

2. Torsional vibration compatibility certification.

3. NFPA 110 compliance certification.

4. Certified rated load test at rated power factor.

O. Manufacturer’s detailed field testing procedures.

P. Field quality control test reports.

Q. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

R. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

S. Maintenance contracts.

T. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

U. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Extra Fuses: One of each type and size.

3. Extra Filter Elements: One of each type, including fuel, oil and air.

1.6 QUALITY ASSURANCE

A. Comply with the following:

1. NFPA 70 (National Electrical Code).

2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for Level 1 system.

3. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).

4. NFPA 30 (Flammable and Combustible Liquids Code).

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1. Authorized service facilities located within 200 miles (320 km) of project site.

D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with engine generator systems of similar size, type, and complexity; manufacturer's authorized installer.

E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

1. Contract maintenance office located within 200 miles (320 km) of project site.

F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and NECA/EGSA 404.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Packaged Engine Generator Set:

1. Caterpillar Inc: www.cat.com/#sle.

2. Cummins Power Generation Inc: www.cumminspower.com/#sle.

3. Generac Power Systems: www.generac.com/industrial/#sle.Generac Power Systems: www.generac.com/industrial/#sle.Generac Power Systems: www.generac.com/industrial/#sle.

4. Kohler Co: www.kohlerpower.com/#sle.

B. Substitutions: See Section 01 60 00 - Product Requirements.

C. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

D. Source Limitations: Furnish engine generator sets and associated components and accessories produced by a single manufacturer and obtained from a single supplier.

2.2 PACKAGED ENGINE GENERATOR SYSTEM

A. Provide new engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. System Description:

1. Application: Emergency/standby.

2. Configuration: Single packaged engine generator set operated independently (not in parallel).

D. Packaged Engine Generator Set:

1. Type: Gaseous (spark ignition).

2. Basis of Design: Generac.

3. Power Rating: , standby.

4. Voltage: 240/120 V, 1 phase, 60 Hz.

5. Main Line Circuit Breaker:

a. Type: Thermal magnetic.

b. Trip Rating: 125 amps.

c. Features:

1) Shunt trip.

2) Auxiliary contacts.

E. Generator Set General Requirements:

1. Prototype tested in accordance with NFPA 110 for Level 1 systems.

2. Factory-assembled, with components mounted on suitable base.

3. List and label engine generator assembly as complying with UL 2200.

4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.

5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.

6. Main Line Circuit Breakers: Provide factory-installed line side connections with suitable lugs for load side connections.

F. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.

1. Altitude: 2,000 FT.

2. Ambient Temperature: Between .

3. Available Natural Gas Pressure: _____ inches water column (_____ kPa).

G. Starting and Load Acceptance Requirements:

1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.

2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.

3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds (NFPA 110, Type 10).

4. Maximum Load Step: Supports 100 percent of rated load in one step.

a. Maximum Voltage Deviation with Load Step: _____ percent.

b. Maximum Frequency Deviation with Load Step: _____ percent.

5. Motor Starting Capability: Supports starting of motor load indicated with a maximum voltage dip of _____ percent.

H. Exhaust Emissions Requirements:

1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.

2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Engineer. Where such modifications are made, provide field emissions testing as necessary for certification.

I. Sound Level Requirements:

1. Comply with applicable noise level regulations.

2.3 ENGINE AND ENGINE ACCESSORY EQUIPMENT

A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.

B. Engine Fuel System - Gaseous (Spark Ignition):

1. Fuel Source: Natural gas.

2. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.

3. Provide components/features indicated and as necessary for operation and/or required by applicable codes, including but not limited to:

    a. Carburetor.

    b. Gas pressure regulators.

    c. Fuel shutoff control valves.

    d. Low gas pressure switches.

    e. Vaporizer (for propane liquid withdrawal).

C. Engine Starting System:

1. System Type: Electric, with DC solenoid-activated starting motor(s).

2. Battery(s):

    a. Battery Type: Lead-acid.

    b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.

    c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.

3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.

4. Battery Charger:

    a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.

    b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.

    c. Listed as complying with UL 1236.

    d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.

e. Provide integral DC output ammeter and voltmeter with five percent accuracy.

f. Provide alarm output contacts as necessary for alarm indications.

5. Battery Heater: Provide thermostatically controlled battery heater to improve starting under cold ambient conditions.

D. Engine Speed Control System (Governor):

1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.

2. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.

E. Engine Lubrication System:

1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.

2. Oil Heater: Provide thermostatically controlled oil heater to improve starting under cold ambient conditions.

F. Engine Cooling System:

1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.

2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.

3. Coolant Heater: Provide thermostatically controlled coolant heater to improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

G. Engine Air Intake and Exhaust System:

1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.

2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.

3. Exhaust Silencer: Provide critical grade or better exhaust silencer with sound attenuation not less than basis of design; select according to manufacturer's recommendations to meet sound performance requirements, where specified.

2.4 ALTERNATOR (GENERATOR)

A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 1; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.

B. Exciter:

1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.

2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.

3. Voltage Regulation (with PMG excitation): Plus/minus 1.0 percent for any constant load from no load to full load.

C. Temperature Rise: Comply with UL 2200.

D. Insulation System: NEMA MG 1, Class H; suitable for alternator temperature rise.

E. Enclosure: NEMA MG 1, drip-proof.

F. Total Harmonic Distortion: Not greater than five percent.

G. Alternator Heater: Provide strip heater to prevent moisture condensation on alternator windings.

2.5 GENERATOR SET CONTROL SYSTEM

A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.

B. Control Panel:

1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.

2. Generator Set Control Functions:

a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).

b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.

c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.

d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.

e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.

f. Time Delay: Programmable for shutdown (engine cooldown) and start (engine warmup).

g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.

3. Generator Set Status Indications:

a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.

b. Current (Amps): For each phase.

c. Frequency (Hz).

d. Real power (W/kW).

e. Reactive power (VAR/kVAR).

f. Apparent power (VA/kVA).

g. Power factor.

h. Duty Level: Actual load as percentage of rated power.

i. Engine speed (RPM).

j. Battery voltage (Volts DC).

k. Engine oil pressure.

l. Engine coolant temperature.

m. Engine run time.

n. Generator powering load (position signal from transfer switch).

4. Generator Set Protection and Warning/Shutdown Indications:

a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:

1) Overcrank (shutdown).

2) Low coolant temperature (warning).

3) High coolant temperature (warning).

4) High coolant temperature (shutdown).

5) Low oil pressure (warning).

6) Low oil pressure (shutdown).

7) Overspeed (shutdown).

8) Low fuel level (warning).

9) Low coolant level (warning/shutdown).

10) Generator control not in automatic mode (warning).

11) High battery voltage (warning).

12) Low cranking voltage (warning).

13) Low battery voltage (warning).

14) Battery charger failure (warning).

b. In addition to NFPA 110 requirements, provide the following protections/indications:

1) High AC voltage (shutdown).

2) Low AC voltage (shutdown).

3) High frequency (shutdown).

4) Low frequency (shutdown).

5) Overcurrent (shutdown).

6) Fuel tank leak (warning), where applicable.

c. Provide contacts for local and remote common alarm.

d. Provide lamp test function that illuminates all indicator lamps.

5. Other Control Panel Features:

a. Event log.

b. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.

c. Remote monitoring capability via PC.

C. Remote Annunciator:

1. Remote Annunciator Mounting: Wall-mounted; Provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.

2. Generator Set Status Indications:

a. Generator powering load (via position signal from transfer switch).

b. Communication functional.

3. Generator Set Warning/Shutdown Indications:

a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following indications:

1) Overcrank (shutdown).

2) Low coolant temperature (warning).

3) High coolant temperature (warning).

4) High coolant temperature (shutdown).

5) Low oil pressure (warning).

6) Low oil pressure (shutdown).

7) Overspeed (shutdown).

8) Low fuel level (warning).

9) Low coolant level (warning/shutdown).

10) Generator control not in automatic mode (warning).

11) High battery voltage (warning).

12) Low cranking voltage (warning).

13) Low battery voltage (warning).

14) Battery charger failure (warning).

b. Provide audible alarm with silence function.

c. Provide lamp test function that illuminates all indicator lamps.

D. Remote Emergency Stop: Provide approved red, mushroom style remote emergency stop button where indicated or required by authorities having jurisdiction.

2.6 GENERATOR SET ENCLOSURE

A. Enclosure Type: Sound attenuating, weather protective.

B. Enclosure Material: Steel or aluminum.

C. Hardware Material: Stainless steel.

D. Color: Manufacturer's standard.

E. Access Doors: Lockable, with all locks keyed alike.

F. Openings: Designed to prevent bird/rodent entry.

G. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.

H. Sound Attenuating Enclosures: Line enclosure with non-hydroscopic, self-extinguishing sound-attenuating material.

I. Utilize an upward discharging radiator hood.

J. Exhaust Silencers: Where exhaust silencers are mounted within enclosure in main engine compartment, insulate silencer to minimize heat dissipation as necessary for operation at rated load under worst case ambient temperature.

K. Enclosure Space Heater: Provide thermostatically controlled enclosure space heater to prevent condensation and improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

2.7 SOURCE QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

C. Generator Set production testing to include, at a minimum:

1. Operation at rated load and rated power factor.

2. Single step load pick-up.

3. Transient and steady state voltage and frequency performance.

4. Operation of safety shutdowns.

D. Diesel Fuel Storage Tanks: Perform pressurized leak test prior to shipment.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of generator sets and auxiliary equipment are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive equipment.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install generator sets and associated accessories in accordance with NECA/EGSA 404.

D. Arrange equipment to provide minimum clearances and required maintenance access.

E. Unless otherwise indicated, mount generator set on properly sized, minimum 6 inch (150 mm) high concrete pad constructed in accordance with Section 03 30 00.

F. Provide required support and attachment in accordance with Section 26 05 29.

G. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.

H. Provide diesel fuel piping and venting in accordance with Section 23 11 13, where not factory installed.

I. Install day tank in accordance with Section 23 11 13.

J. Install diesel fuel maintenance system in accordance with manufacturer's instructions.

1. Position fuel intake and fuel return within tanks to maximize fuel circulation.

2. Do not exceed lift capabilities of circulating pump.

3. Provide isolation valves, foot valves, priming tees, relief valves, and check valves where called for by manufacturer.

K. Provide engine exhaust piping in accordance with Section 23 51 00, where not factory installed.

1. Include piping expansion joints, piping insulation, thimble, condensation trap/drain, rain cap, hangers/supports, etc. as indicated or as required.

2. Do not exceed manufacturer's maximum back pressure requirements.

L. Install exhaust silencer in accordance with Section 23 51 00, where not factory installed.

M. Provide grounding and bonding in accordance with Section 26 05 26.

N. Identify system wiring and components in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Provide services of a manufacturer's authorized representative to prepare and start systems and perform inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

C. Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.

D. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

E. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.

F. Preliminary inspection and testing to include, at a minimum:

1. Inspect each system component for damage and defects.

2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.

3. Check for proper oil and coolant levels.

G. Prepare and start system in accordance with manufacturer's instructions.

H. Perform acceptance test in accordance with NFPA 110.

I. Inspection and testing to include, at a minimum:

1. Verify compliance with starting and load acceptance requirements.

2. Verify voltage and frequency; make required adjustments as necessary.

3. Verify phase sequence.

4. Verify control system operation, including safety shutdowns.

5. Verify operation of auxiliary equipment and accessories (e.g. battery charger, heaters, etc.).

6. Perform load tests in accordance with NFPA 110 (1.5 hour building load test followed by 2 hour full load test).

J. Provide field emissions testing where necessary for certification.

K. Sound Level Tests: Measure sound levels for compliance with specified requirements. Identify and report ambient noise conditions.

L. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

M. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

A. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of four hours of training.

3. Instructor: Manufacturer's authorized representative.

4. Location: At project site.

B. After successful acceptance test and just prior to Substantial Completion, replace air, oil, and fuel filters and fill fuel storage tank.

3.6 PROTECTION

A. Protect installed engine generator system from subsequent construction operations.

END OF SECTION 26 32 13

SECTION 26 36 00
TRANSFER SWITCHES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Transfer switches for low-voltage (600 V and less) applications and associated accessories:

1. Automatic transfer switches.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

C. Section 26 05 29 - Hangers and Supports for Electrical Systems.

D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

C. NEMA ICS 10 Part 1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment; 2020.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.

2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.

3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Coordinate the work with placement of supports, anchors, etc. required for mounting.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.

1. Identify mounting conditions required for equipment seismic qualification.

1.6 QUALITY ASSURANCE

A. Comply with the following:

1. NFPA 70 (National Electrical Code).

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

2.2 TRANSFER SWITCHES

A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Construction Type: Either "contactor type" (open contact) or "breaker type" (enclosed contact) transfer switches complying with specified requirements are acceptable.

D. Comply with NEMA ICS 10 Part 1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).

E. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.

F. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.

G. Switching Methods:

1. Obtain control power for transfer operation from line side of source to which the load is to be transferred.

H. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.

I. Enclosures:

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

2. Finish: Manufacturer's standard unless otherwise indicated.

J. Short Circuit Current Rating:

1. Withstand and Closing Rating: Provide transfer switches, when protected by the supply side overcurrent protective devices to be installed, with listed withstand and closing rating not less than the available fault current at the installed location as indicated on the drawings.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required support and attachment in accordance with Section 26 05 29.

E. Install transfer switches plumb and level.

F. Unless otherwise indicated, mount floor-mounted transfer switches on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 30 00.

G. Provide grounding and bonding in accordance with Section 26 05 26.

H. Identify transfer switches and associated system wiring in accordance with Section 26 05 53.

3.2 MAINTENANCE

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

END OF SECTION 26 36 00

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Interior luminaires.

B. Emergency lighting units.

C. Exit signs.

D. Ballasts and drivers.

E. LED replacement lamps.

1.2 RELATED REQUIREMENTS

A. Section 26 05 29 - Hangers and Supports for Electrical Systems.

B. Section 26 05 33.16 - Boxes for Electrical Systems.

C. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.

D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 06 50.16 - Lighting Fixture Schedule.

1.3 REFERENCE STANDARDS

A. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.

B. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.

C. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems; 2006.

D. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

H. UL 1598 - Luminaires; Current Edition, Including All Revisions.

I. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:

a. Include estimated useful life, calculated based on IES LM-80 test data.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 – PRODUCTS

2.1 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

A. Manufacturers:

1. Acuity Brands, Inc: www.acuitybrands.com/#sle.

B. Provide products that comply with requirements of NFPA 70.

C. Provide products that are listed and labeled as complying with UL 1598, where applicable.

D. Provide products listed, classified, and labeled as suitable for the purpose intended.

E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

H. LED Luminaires:

1. Components: UL 8750 recognized or listed as applicable.

2. Tested in accordance with IES LM-79 and IES LM-80.

3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.3 EMERGENCY LIGHTING UNITS

A. Manufacturers:

1. Acuity Brands, Inc: www.acuitybrands.com/#sle.

B. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

C. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

D. Battery:

1. Size battery to supply all connected lamps, including emergency remote heads where indicated.

E. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

F. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.4 EXIT SIGNS

A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.

1. Number of Faces: Single- or double-face as indicated or as required for installed location.

2. Directional Arrows: As indicated or as required for installed location.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.

B. Install products in accordance with manufacturer's instructions.

C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

D. Provide required support and attachment in accordance with Section 26 05 29.

E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

F. Install accessories furnished with each luminaire.

G. Bond products and metal accessories to branch circuit equipment grounding conductor.

H. Emergency Lighting Units:

I. Exit Signs:

J. Install lamps in each luminaire.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.

E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.4 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.5 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

B. See Section 01 79 00 - Demonstration and Training, for additional requirements.

END OF SECTION 26 51 00

SECTION 26 56 00
EXTERIOR LIGHTING

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Exterior luminaires.

B. Poles and accessories.

C. Luminaire accessories.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

C. Section 26 05 29 - Hangers and Supports for Electrical Systems.

D. Section 26 05 33.16 - Boxes for Electrical Systems.

E. Section 26 06 50.16 - Lighting Fixture Schedule.

F. Section 26 09 23 - Lighting Control Devices.

1. Includes automatic controls for lighting including outdoor motion sensors, time switches, and outdoor photo controls.

2. Includes lighting contactors.

G. Section 26 27 26 - Wiring Devices: Receptacles for installation in poles.

H. Section 26 28 13 - Fuses.

I. Section 26 51 00 - Interior Lighting.

1.3 REFERENCE STANDARDS

A. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals; 2013, with Editorial Revision (2022).

B. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.

C. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019.

D. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.

E. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.

F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

G. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2000 (Reaffirmed 2006).

H. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2023.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 1598 - Luminaires; Current Edition, Including All Revisions.

K. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.

2. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:

1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

2. Provide photometric calculations where luminaires are proposed for substitution upon request.

3. Provide structural calculations for each pole proposed for substitution.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:

a. Include estimated useful life, calculated based on IES LM-80 test data.

b. Include IES LM-79 test report upon request.

2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.

D. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.

E. Field Quality Control Reports.

1. Include test report indicating measured illumination levels.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide 2-year manufacturer warranty for all LED luminaires, including drivers.

C. Provide 3-year manufacturer warranty for LED replacement lamps.

D. Provide 3-year manufacturer warranty for LED retrofit luminaire conversion kits.

PART 2 – PRODUCTS

2.1 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

A. Manufacturers:

1. Acuity Brands, Inc www.acuitybrands.com/#sle.

2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Provide products that comply with requirements of NFPA 70.

C. Provide products that are listed and labeled as complying with UL 1598, where applicable.

D. Provide products listed, classified, and labeled as suitable for the purpose intended.

E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

H. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

I. Recessed Luminaires:

1. Ceiling Compatibility: Comply with NEMA LE 4.

2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.

3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

J. LED Luminaires:

1. Components: UL 8750 recognized or listed as applicable.

2. Tested in accordance with IES LM-79 and IES LM-80.

3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.3 POLES

A. Manufacturers:

1. Acuity Brands, Inc www.acuitybrands.com/#sle.

2. Substitutions: See Section 01 60 00 - Product Requirements.

B. All Poles:

1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.

2. Structural Design Criteria:

a. Comply with AASHTO LTS.

b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.

2.4 ACCESSORIES

A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.

B. Install products in accordance with manufacturer's instructions.

C. Install luminaires in accordance with NECA/IESNA 501.

D. Provide required support and attachment in accordance with Section 26 05 29.

E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

F. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

G. Pole-Mounted Luminaires:

1. Maintain the following minimum clearances:

a. Comply with IEEE C2.

b. Comply with utility company requirements.

2. Foundation-Mounted Poles:

   a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 03 30 00.

      1) Install anchor bolts plumb per template furnished by pole manufacturer.

      2) Position conduits to enter pole shaft.

   b. Install foundations plumb.

   c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.

   d. Tighten anchor bolt nuts to manufacturer's recommended torque.

   e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.

   f. Install anchor base covers or anchor bolt covers as indicated.

3. Grounding:

   a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.

4. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.

H. Install accessories furnished with each luminaire.

I. Bond products and metal accessories to branch circuit equipment grounding conductor.

J. Install lamps in each luminaire.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

E. Measure illumination levels at night with calibrated meters to verify compliance with performance requirements. Record test results in written report to be included with submittals.

3.5 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

B. See Section 01 79 00 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

D. Just prior to Substantial Completion, replace all lamps that have failed.

3.7 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

3.8 ATTACHMENTS

A. Luminaire schedule. (Reference Electrical Drawings).

END OF SECTION 26 56 00

SECTION 27 05 33.13
CONDUIT FOR COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. Stainless steel rigid metal conduit (RMC).

C. Galvanized steel intermediate metal conduit (IMC).

D. Stainless steel intermediate metal conduit (IMC).

E. PVC-coated galvanized steel rigid metal conduit (RMC).

F. Flexible metal conduit (FMC).

G. Liquidtight flexible metal conduit (LFMC).

H. Galvanized steel electrical metallic tubing (EMT).

I. Stainless steel electrical metallic tubing (EMT).

J. Rigid polyvinyl chloride (PVC) conduit.

K. Electrical nonmetallic tubing (ENT).

L. Liquidtight flexible nonmetallic conduit (LFNC).

M. Reinforced thermosetting resin conduit (RTRC).

N. High-density polyethylene (HDPE) conduit.

O. Polyvinyl chloride (PVC) plastic utilities duct.

P. Inside-plant flexible nonmetallic communications raceway/innerduct.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete encasement of conduits.

B. Section 07 84 00 - Firestopping.

C. Section 26 05 33.13 - Conduit for Electrical Systems.

D. Section 27 05 29 - Hangers and Supports for Communications Systems.

E. Section 27 10 00 - Structured Cabling.

F. Section 31 23 16 - Excavation.

G. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

H. Section 31 23 23 - Fill: Bedding and backfilling.

I. Section 33 71 19 - Electrical Underground Ducts, Ductbanks, and Manholes.

1.3 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing – Steel (EMT-S); 2020.

C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.

D. ASTM F2160 - Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD); 2016.

E. ASTM F2176 - Standard Specification for Mechanical Couplings Used on Polyethylene Conduit, Duct and Innerduct; 2017.

F. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition; 2022.

G. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.

H. BICSI TDMM - Telecommunications Distribution Methods Manual, 14th Edition; 2020.

I. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

J. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.

K. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.

L. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

M. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.

N. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.

O. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.

P. NEMA TC 7 - Solid-Wall Coilable and Straight Electrical Polyethylene Conduit; 2021.

Q. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series; 2015.

R. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

S. TIA-568.0 - Generic Telecommunications Cabling for Customer Premises; 2020e.

T. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).

U. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

V. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.

W. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

X. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

Y. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

Z. UL 651A - Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit; Current Edition, Including All Revisions.

AA. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

BB. UL 797A - Electrical Metallic Tubing - Aluminum and Stainless Steel; Current Edition, Including All Revisions.

CC. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

DD. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

EE. UL 2024 - Standard for Cable Routing Assemblies and Communications Raceways; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate minimum sizes of conduits with actual type and quantity of cables to be installed.

2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts.

3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.

4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.

5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of communications cables until installation of conduit between termination points is complete.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

C. Shop Drawings:

1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.

2. Include proposed locations of roof penetrations and methods for sealing.

D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2-inch (53 mm) trade size and larger.

1.6 QUALITY ASSURANCE

A. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions and shop drawings.

B. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.

B. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 – PRODUCTS

2.1 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, TIA-569, BICSI ITSIMM, BICSI TDMM, manufacturers' instructions, and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:

1. Under Slab on Grade: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).

2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, reinforced thermosetting resin conduit (RTRC), or high-density polyethylene (HDPE) conduit.

3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, reinforced thermosetting resin conduit (RTRC), or high-density polyethylene (HDPE) conduit.

4. Where rigid polyvinyl chloride (PVC) conduit or high-density polyethylene (HDPE) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), or schedule 80 rigid PVC conduit where emerging from underground.

5. Where rigid polyvinyl chloride (PVC) conduit larger than 2-inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit (RMC) elbows, stainless steel rigid metal conduit (RMC) elbows, galvanized steel intermediate metal conduit (IMC) elbows, stainless steel intermediate metal conduit (IMC) elbows, PVC-coated galvanized steel rigid metal conduit (RMC) elbows, or concrete-encased PVC elbows for bends.

6. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.

7. Where galvanized steel electrical metallic tubing (EMT) is installed in direct contact with earth, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.

8. Where galvanized rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) emerges from concrete into soil, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches (100 mm) on either side of where conduit emerges.

D. Embedded Within Concrete:

1. Within Slab on Grade: Not permitted.

2. Within Slab Above Ground: Not permitted.

3. Within Slab Above Ground: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC). Embed within structural slabs only where approved by Structural Engineer.

4. Where aluminum rigid metal conduit (RMC) and aluminum electrical metallic tubing (EMT) is installed in concrete, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.

E. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

F. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), or inside-plant flexible nonmetallic communications raceway/innerduct.

G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), or schedule 80 rigid PVC conduit.

1. Locations subject to physical damage include, but are not limited to:

a. Where exposed below 8 feet (2.4 m), except within electrical and communication rooms or closets.

b. Where exposed below 20 feet (6.1 m) in warehouse areas.

J. Exposed, Interior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or stainless steel intermediate metal conduit (IMC).

1. Locations subject to severe physical damage include, but are not limited to:

a. High traffic industrial and warehouse areas where exposed below 8 feet (2.4 m), except within electrical and communication rooms or closets.

b. Where exposed below 20 feet (6.1 m) in industrial manufacturing areas.

2.2 CONDUIT - GENERAL REQUIREMENTS

A. Comply with NFPA 70 and TIA-569.

B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.

C. Provide conduit, fittings, supports, and accessories required for complete communications pathway.

D. Provide products listed, classified, and labeled as suitable for purpose intended.

E. Maximum Number of Communications Outlet Boxes per Continuous Conduit Homerun: Two.

F. Minimum Conduit Size, Unless Otherwise Indicated:

1. Communications Outlet Box: 3/4-inch (21 mm) trade size.

2. Continuous Conduit Homerun Serving One Communications Outlet Box: 1-inch (27 mm) trade size.

3. Continuous Conduit Homerun Serving Two Communications Outlet Boxes: 1-inch (27 mm) trade size.

4. Continuous Conduit Homerun Serving Three Communications Outlet Boxes: 1-1/4-inch (35 mm) trade size.

G. Where conduit size is not indicated, size to comply with NFPA 70, TIA-569, and BICSI TDMM, but not less than applicable minimum size requirements specified. Where specified standards differ, comply with most stringent.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:

1. Allied Tube & Conduit, a division of Atkore International; _____: www.alliedeg.us/#sle.

2. Nucor Tubular Products; _____: www.nucortubular.com/#sle.

3. Western Tube, a division of Zekelman Industries; _____: www.westerntube.com/#sle.

4. Wheatland Tube, a division of Zekelman Industries; _____: www.wheatland.com/#sle.

5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:

1. Manufacturers:

a. ABB; T&B; _____: www.electrification.us.abb.com/#sle.

b. Allied Tube & Conduit, a division of Atkore International; _____: www.alliedeg.us/#sle.

c. Bridgeport Fittings Inc; _____: www.bptfittings.com/#sle.

d. Emerson Electric Co; O-Z/Gedney; _____: www.emerson.com/#sle.

e. Substitutions: See Section 01 60 00 - Product Requirements.

2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.

3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.

4. Material: Use steel or malleable iron.

a. Do not use die cast zinc fittings.

5. Connectors and Couplings: Use threaded fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

6. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.

    a. Manufacturers:

        1) Madison Electric Products, a division of Southwire Company; _____: www.meproducts.net/#sle.

        2) Substitutions: See Section 01 60 00 - Product Requirements.

    b. Comply with TIA-568.0 minimum bend radius requirements for fiber optic cables.

2.4 STAINLESS STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC stainless steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6A.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6A.

2. Material: Use stainless steel with corrosion resistance equivalent to conduit.

3. Connectors and Couplings: Use threaded fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

4. Conduit Bodies: Standard conduit bodies designed for electrical raceways are not permitted.

2.5 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:

1. Allied Tube & Conduit, a division of Atkore International; _____: www.alliedeg.us/#sle.

2. Nucor Tubular Products; _____: www.nucortubular.com/#sle.

3. Western Tube, a division of Zekelman Industries; _____: www.westerntube.com/#sle.

4. Wheatland Tube, a division of Zekelman Industries; _____: www.wheatland.com/#sle.

5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:

1. Manufacturers:

a. ABB; T&B; _____: www.electrification.us.abb.com/#sle.

b. Allied Tube & Conduit, a division of Atkore International; _____: www.alliedeg.us/#sle.

c. Bridgeport Fittings, LLC; _____: www.bptfittings.com/#sle.

d. Emerson Electric Co; O-Z/Gedney; _____: www.emerson.com/#sle.

e. Substitutions: See Section 01 60 00 - Product Requirements.

2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.

3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.

4. Material: Use steel or malleable iron.

a. Do not use die cast zinc fittings.

5. Connectors and Couplings: Use threaded fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

6. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.

a. Manufacturers:

1) Madison Electric Products, a division of Southwire Company; _____: www.meproducts.net/#sle.

2) Substitutions: See Section 01 60 00 - Product Requirements.

b. Comply with TIA-568.0 minimum bend radius requirements for fiber optic cables.

2.6 STAINLESS STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.

2. Material: Use stainless steel with corrosion resistance equivalent to conduit.

3. Connectors and Couplings: Use threaded fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

4. Conduit Bodies: Standard conduit bodies designed for electrical raceways are not permitted.

2.7 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:

1. ABB; Ocal; _____: www.electrification.us.abb.com/#sle.

2. Calbond, a division of Atkore International; _____ www.calbond.com/#sle

3. Robroy Industries; _____: www.robroy.com/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch (1.02 mm).

D. PVC-Coated Boxes and Fittings:

1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.

2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.

3. Material: Use steel or malleable iron.

4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch (1.02 mm).

5. Conduit Bodies: Standard conduit bodies designed for electrical raceways are not permitted.

E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch (0.38 mm).

2.8 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2. Material: Use steel or malleable iron.

3. Connectors and Couplings: Use compression/gland or set-screw type.

a. Do not use indenter type connectors and couplings.

4. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.

a. Comply with TIA-568.0 minimum bend radius requirements for fiber optic cables.

2.9 STAINLESS STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT stainless steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797A.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2. Material: Use stainless steel with corrosion resistance equivalent to conduit.

3. Connectors and Couplings: Use compression/gland or set-screw type.

4. Conduit Bodies: Standard conduit bodies designed for electrical raceways are not permitted.

2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage.

B. Fittings:

1. Manufacturer: Same as manufacturer of conduit to be connected.

2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

3. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.

a. Comply with TIA-568.0 minimum bend radius requirements for fiber optic cables.

2.11 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

A. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).

B. Supports: As recommended by manufacturer.

C. Fittings: Same type and manufacturer as conduit to be connected.

1. Conduit Bodies: Standard conduit bodies designed for electrical raceways are not permitted.

2.12 HIGH-DENSITY POLYETHYLENE (HDPE) CONDUIT

A. Description: NFPA 70, Type HDPE high-density polyethylene solid-wall conduit complying with ASTM F2160 and NEMA TC 7; list and label as complying with UL 651A; Schedule 40 unless otherwise indicated.

B. Joining Methods: Approved by HDPE conduit manufacturer.

C. Mechanical Fittings: Comply with ASTM F2176; list and label as complying with UL 651A.

2.13 INSIDE-PLANT FLEXIBLE NONMETALLIC COMMUNICATIONS RACEWAY/INNERDUCT

A. Description: Flexible, corrugated, nonmetallic communications raceway and associated fittings listed and labeled as complying with UL 2024; also suitable for installation as innerduct.

B. Use only with approved cables in accordance with listing.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in accordance with NECA 1, BICSI ITSIMM, and BICSI N1.

C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.

D. Galvanized Steel Intermediate Metal Conduit (IMC): Install in accordance with NECA 101.

E. PVC-Coated Galvanized Steel Rigid Metal Conduit (RMC): Install using only tools approved by manufacturer.

F. Galvanized Steel Electrical Metallic Tubing (EMT): Install in accordance with NECA 101.

G. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.

H. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction.

2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

I. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.

2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.

3. Use suitable adapters where required to transition from one type of conduit to another.

4. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.

5. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect cables.

6. Secure joints and connections to provide mechanical strength and electrical continuity.

J. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.

2. Make penetrations perpendicular to surfaces unless otherwise indicated.

3. Provide sleeves and/or slots for penetrations as indicated or as required to facilitate installation.

4. Conceal bends for conduit risers emerging above ground.

5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.

6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.

7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 84 00.

K. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed cables or connected equipment. This includes, but is not limited to:

1. Where conduits cross structural joints intended for expansion, contraction, or deflection.

2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.

3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.

4. Where conduits are subject to earth movement by settlement or frost.

L. Provide grounding and bonding.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

D. Correct deficiencies and replace damaged or defective conduits.

END OF SECTION 27 05 33.13

SECTION 28 10 00
ACCESS CONTROL

PART 1 – GENERAL

1.1 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware: Electrically operated door hardware, for interface with access control system.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.2 DEFINITIONS

A. Access Control Cloud Services: Subscription-based hosted application utilizing Software as a Service (SaaS) delivery model in lieu of on-premises servers/software.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

B. UL 294 - Access Control System Units; Current Edition, Including All Revisions.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Access Control Units:

1. Bosch Security Systems; _____: www.boschsecurity.us/#sle.

2. Honeywell International, Inc; _____: www.honeywellaccess.com/#sle.

3. Schneider Electric; EcoStruxure Security Expert: www.se.com/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Access Control Software:

1. Honeywell International, Inc; _____: www.honeywellaccess.com/#sle.

2. Schneider Electric; EcoStruxure Security Expert: www.se.com/#sle.

3. Substitutions: See Section 01 60 00 - Product Requirements.

C. Access Control Cloud Services:

1. Schneider Electric; EcoStruxure Access Expert: www.se.com/#sle.

2. Substitutions: See Section 01 60 00 - Product Requirements.

D. Readers and Keypads:

1. Bosch Security Systems; _____: www.boschsecurity.us/#sle.

2. Honeywell International, Inc; _____: www.honeywellaccess.com/#sle.

3. Schneider Electric; EcoStruxure Security Expert: www.se.com/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 ACCESS CONTROL SYSTEM REQUIREMENTS

A. Provide new access control system consisting of required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. System Battery Backup: Provide batteries/uninterruptible power supplies (UPS) as required per Chelan County standards.

C. Surge Protection:

1. Provide surge protection for readers and door strikes/locks.

a. Products:

1) Substitutions: See Section 01 60 00 - Product Requirements.

2. Provide equipment power surge protection where electrical distribution system surge protection is not provided.

D. Access Control Points:

1. See article "ACCESS CONTROL POINT PERIPHERALS" below for device descriptions.

E. Provide products listed, classified, and labeled as suitable for the purpose intended.

1. Access Control Units and Readers: Listed and labeled as complying with UL 294.

2.3 ACCESS CONTROL UNITS AND SOFTWARE

A. Provide access control units and software compatible with readers to be connected.

B. Unless otherwise indicated, provide software and licenses required for fully operational system.

2.4 ACCESS CONTROL POINT PERIPHERALS

A. Provide devices compatible with control units and software.

B. Provide devices suitable for operation under the service conditions at the installed location.

C. Door Locking Devices (Electric Strikes and Magnetic Locks): Comply with Section 08 71 00.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of system components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive system components.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to system.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install access control system in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Provide grounding and bonding in accordance with Section 26 05 26.

D. Identify system wiring and components in accordance with Section 26 05 53.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Prepare and start system in accordance with manufacturer's instructions.

C. Program system parameters according to requirements of Owner.

D. Test for proper interface with other systems.

E. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.4 MAINTENANCE

A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION 28 10 00

SECTION 28 20 00
VIDEO SURVEILLANCE

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Video surveillance system requirements.

B. Video recording and viewing equipment.

C. Cameras.

D. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 29 - Hangers and Supports for Electrical Systems.

C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

D. Section 28 10 00 - Access Control: For interface with video surveillance system.

1.3 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.

B. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

D. NECA 303 - Standard for Installing and Maintaining Closed-Circuit Television (CCTV) Systems; 2019.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of cameras with structural members, ductwork, piping, equipment, luminaires, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.

2. Coordinate the work with other installers to provide power for cameras and equipment at required locations.

3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 QUALITY ASSURANCE

A. Comply with the following:

1. NFPA 70.

2. Applicable TIA/EIA standards.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

2.2 VIDEO SURVEILLANCE SYSTEM

A. Provide new video surveillance system consisting of all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. System Description: IP system with connection to network (IP) cameras.

C. Interface with Other Systems:

1. Provide products compatible with other systems requiring interface with video surveillance system.

2. Interface with access control system as specified in Section 28 10 00.

a. Capable of affecting camera/video operation for selected access control system events.

D. Provide products listed, classified, and labeled as suitable for the purpose intended.

E. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B, consumer application.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install video surveillance system in accordance with NECA 1 (general workmanship) and NECA 303.

B. Install products in accordance with manufacturer's instructions.

C. Provide required support and attachment in accordance with Section 26 05 29.

D. Provide grounding and bonding in accordance with Section 26 05 26.

E. Identify system wiring and components in accordance with Section 26 05 53.

3.2 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Prepare and start system in accordance with manufacturer's instructions.

C. Adjust cameras to provide desired field of view and produce suitable images under all service lighting conditions.

D. Program system parameters according to requirements of Owner.

E. Test for proper interface with other systems.

F. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

END OF SECTION 28 20 00

SECTION 28 46 00
FIRE DETECTION AND ALARM

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Fire alarm system design and installation, including all components, wiring, and conduit.

B. Transmitters for communication with supervising station.

C. Circuits from protected premises to supervising station, including conduit.

D. Replacement and removal of existing fire alarm system components, wiring, and conduit indicated.

1.2 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping: Materials and methods for work to be performed by this installer.

B. Designed using manufacturer's product-specific design software or based on manufacturer's pre-engineered design suitable for the application.

C. Section 08 71 00 - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.

D. Section 14 24 00 - Hydraulic Elevators: Elevator systems monitored and controlled by fire alarm system.

E. Section 21 13 00 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.

F. Section 23 33 00 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

G. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems: Requirements for the seismic qualification of equipment specified in this section.

H. Section 27 51 29.13 - Rescue Assistance Signal Systems: Two-way emergency communication systems for areas of refuge/rescue assistance.

1.3 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Drawings must be prepared using AutoCAD Release ___.

C. Evidence of designer qualifications.

D. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:

1. Copy (if any) of list of data required by authority having jurisdiction.

2. NFPA 72 "Record of Completion", filled out to the extent known at the time.

3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.

4. System zone boundaries and interfaces to fire safety systems.

5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.

6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.

7. List of all devices on each signaling line circuit, with spare capacity indicated.

8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.

9. Air-Sampling Smoke Detection Systems: Include air-sampling pipe network layout with sampling ports identified; include calculations demonstrating compliance with specified requirements.

10. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.

11. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.

12. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.

13. Certification by Contractor that the system design complies with Contract Documents.

14. Do not show existing components to be removed.

E. Manufacturer's equipment seismic qualification certification.

F. Evidence of installer qualifications.

G. Evidence of instructor qualifications; training lesson plan outline.

H. Evidence of maintenance contractor qualifications, if different from installer.

I. Inspection and Test Reports:

1. Submit inspection and test plan prior to closeout demonstration.

2. Submit documentation of satisfactory inspections and tests.

3. Submit NFPA 72 "Inspection and Test Form," filled out.

J. Operating and Maintenance Data: See Section 01 78 00 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:

1. Complete set of specified design documents, as approved by authority having jurisdiction.

2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.

3. Contact information for firm that will be providing contract maintenance and trouble call-back service.

4. List of recommended spare parts, tools, and instruments for testing.

5. Replacement parts list with current prices, and source of supply.

6. Detailed troubleshooting guide and large scale input/output matrix.

7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.

8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

K. Project Record Documents: See Section 01 78 00 for additional requirements; have one set available during closeout demonstration:

1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.

2. "As installed" wiring and schematic diagrams, with final terminal identifications.

3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

L. Closeout Documents:

1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.

2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.

3. Certificate of Occupancy.

4. Report on training results.

M. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data and place in spare parts cabinet.

3. In addition to the items in quantities indicated in PART 2, furnish the following:

a. All tools, software, and documentation necessary to modify the fire alarm system using Owner's personnel; minimum modification capability to include addition and deletion of devices, circuits, and zones, and changes to system description, operation, and evacuation and instructional messages.

b. One copy, on CD-ROM, of all software not resident in read-only-memory.

c. Extra Fuses: Two for each installed fuse; store inside applicable control cabinet.

1.5 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.

C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Fire Alarm Control Units and Accessories:

1. Honeywell Security & Fire Solutions/Gamewell-FCI; _____: www.gamewell-fci.com/#sle.

2. Provide control units made by the same manufacturer.

B. Initiating Devices and Notification Appliances:

1. Honeywell Security & Fire Solutions/Gamewell-FCI; _____: www.gamewell-fci.com/#sle.

2. Same manufacturer as control units.

3. Provide initiating devices and notification appliances made by the same manufacturer, where possible.

C. Substitutions: See Section 01 60 00 - Product Requirements.

1. For other acceptable manufacturers of control units specified, submit product data showing equivalent features and compliance with Contract Documents.

2. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with Contract Documents.

2.2 FIRE ALARM SYSTEM

A. Fire Alarm System: Provide a new automatic fire detection and alarm system:

1. Provide all components necessary, regardless of whether shown in Contract Documents or not.

2. Protected Premises: Entire building shown on drawings.

3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:

   a. ADA Standards.

   b. The requirements of the State Fire Marshal.

   c. The requirements of the local authority having jurisdiction , which is _____.

   d. Applicable local codes.

   e. Contract Documents (drawings and specifications).

   f. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.

4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.

5. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.

6. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.

7. Program notification zones and voice messages as directed by Owner.

8. Hearing Impaired Occupants: Provide visible notification devices in all public areas and in dwelling units.

9. Fire Command Center: Location indicated on drawings.

10. Fire Alarm Control Unit: New, located at fire command center.

11. Combined Systems: Do not combine fire alarm system with other non-fire systems.

B. Supervising Stations and Fire Department Connections:

1. Public Fire Department Notification: By on-premises supervising station.

2. On-Premises Supervising Station: Existing proprietary station operated by Owner, located at _____.

3. Means of Transmission to On-Premises Supervising Station: Directly connected noncoded system.

C. Circuits:

1. Initiating Device Circuits (IDC): Class B, Style A.

2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.

3. Notification Appliance Circuits (NAC): Class B, Style W.

D. Spare Capacity:

1. Initiating Device Circuits: Minimum 25 percent spare capacity.

2. Notification Appliance Circuits: Minimum 25 percent spare capacity.

3. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.

E. Power Sources:

1. Primary: Dedicated branch circuits of the facility power distribution system.

2. Secondary: Storage batteries.

3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.

4. Each Computer System: Provide uninterruptible power supply (UPS).

F. Seismic Qualification: Provide fire alarm system and associated components suitable for application under the seismic design criteria specified in Section 26 05 48 where required. Include certification of compliance with submittals.

2.3 EXISTING COMPONENTS

A. On-Premises Supervising Station: Include as part of this work all modifications necessary to existing supervising station to accommodate new fire alarm work.

B. Clearly label components that are "Not In Service."

C. Remove unused existing components and materials from site and dispose of properly.

2.4 FIRE SAFETY SYSTEMS INTERFACES

A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:

1. Sprinkler water control valves.

2. Dry-pipe sprinkler system pressure.

3. Dry-pipe sprinkler valve room low temperature.

4. Fire pump(s).

B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:

1. Sprinkler water flow.

2. Kitchen hood suppression activation; also disconnect fuel source from cooking equipment.

3. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.

4. Duct smoke detectors.

C. Elevators:

1. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.

2. Elevator Machine Room Heat Detector: Shut down elevator power prior to hoistway sprinkler activation.

3. Sprinkler pressure or waterflow: Shut down elevator power prior to hoistway sprinkler activation.

D. HVAC:

1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.

E. Doors:

2.5 COMPONENTS

A. General:

1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.

2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.

B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.

C. Master Control Unit: _____.

D. Remote Annunciators: _____.

E. Addressable Modules:

1. Provide addressable modules suitable for connection to fire alarm control unit signaling line circuits.

2. Unless otherwise indicated, use addressable modules only in clean, dry, indoor, nonhazardous locations.

F. Initiating Devices:

1. Addressable Systems:

a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.

b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.

2. Manual Pull Stations: _____.

G. Notification Appliances:

H. Circuit Conductors: Copper or optical fiber; provide 200 feet (60 m) extra; color code and label.

I. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.

J. Locks and Keys: Deliver keys to Owner.

1. Provide the same standard lock and key for each key operated switch and lockable panel and cabinet; provide 5 keys of each type

K. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.

1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.

2. Provide one for each control unit where operations are to be performed.

3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.

4. Provide extra copy with operation and maintenance data submittal.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and Contract Documents.

B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.

C. Obtain Owner's approval of locations of devices, before installation.

D. Install instruction cards and labels.

3.2 INSPECTION AND TESTING FOR COMPLETION

A. Notify Owner 7 days prior to beginning completion inspections and tests.

B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.

E. Provide all tools, software, and supplies required to accomplish inspection and testing.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

G. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

H. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.

1. Record all system operations and malfunctions.

2. If a malfunction occurs, start diagnostic period over after correction of malfunction.

3. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.

4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.3 OWNER PERSONNEL INSTRUCTION

A. Provide the following instruction to designated Owner personnel:

1. Hands-On Instruction: On-site, using operational system.

2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.

B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:

1. Initial Training: 1 session pre-closeout.

C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:

1. Initial Training: 1 session pre-closeout.

D. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

E. Provide means of evaluation of trainees suitable to type of training given; report results to Owner.

3.4 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.

1. Be prepared to conduct any of the required tests.

2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.

3. Have authorized technical representative of control unit manufacturer present during demonstration.

4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.

5. Repeat demonstration until successful.

B. Perform post-occupancy instruction within 3 months after Substantial Completion.

END OF SECTION 28 46 00

SECTION 31 20 00 – EARTHWORK

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Provide all earthwork, including excavating, filling, grading, backfilling, construction/storm water permits and monitoring, etc., required for this Work as indicated on the Drawings, specified herein and as required to provide a complete and finished Project.

B. The Contract Sum, as bid, includes all earthmoving, excavating, filling, backfilling, grading, importing of materials and off-site disposal of excess materials, if any, as required to accomplish the work as shown on the Drawings and specified herein.

C. Unit prices which are include in the agreement form apply only to **changes in the Work** which may require importing of additional material, additional off-site disposal of material, removal of 'rock' and other **additional** work, and have no bearing on the basic work of the Contract including Alternates, as indicated on the Drawings and specified herein.

1.2 SUBMITTALS

A. Submit samples of all imported materials to Architect/Engineer for approval at least 7 days prior to scheduled start of use. Certify to Architect/Engineer that all materials of each type used in the work is true to approved type sample.

1.3 QUALITY ASSURANCE

A. Safety Codes and Standards

1. Perform all earthwork in compliance with applicable requirements of governing authorities having jurisdiction, including the applicable Rules and Regulations of OSHA 1518, Safety and Health Regulations for Construction, Chapter XIII of Title 289, Code of Federal Regulations and of OSHA Part 1910, Occupational Safety and Health Standards, Chapter XVII of Title 29, Cod of Federal Regulations and the Regulations of Washington Industrial Safety and Health Act.

B. Tests and Inspections

1. An Independent Special Inspector may perform tests and inspections of work under this Section. Relative compactions will be determined as specified under AASHO: T180, or similar approved standard. Contractor shall cooperate in all respects to allow and assist in testing. The Owner's independent testing shall not relieve the Contractor from compliance with the work of this Section.

C. Pre-Contract Soils Investigation

1. Pre-contract soils sampling and analysis has been performed at the Project site and the Owner cannot, and does not, guarantee that soils composition will be uniform throughout the site. It is assumed that soils encountered will be reasonably uniform and consolidated and of adequate bearing capacity for the relatively light structural loads imposed by the construction under this Contract (i.e., 1,500 lbs/sf maximum). A copy of the Report is included as an Appendix to this Section.

2. Contractor shall anticipate and make allowance for an average and reasonable amount of variation from the sampled soils types, in the area of the work. Contractor (bidders) shall familiarize himself with the site as fully as practical. Contractor (bidders) shall also account for seasonal variations and anticipate methods to obtain proper moisture for compaction. Claims for unforeseeable additional cost of earthwork will only be considered if Contractor encounters rock or soils substantially and extensively different and more difficult than those classified in the sample logs.

D. Layout and Control

1. General Contractor shall lay out all lines and levels. He shall employ a field engineer acceptable to the Architect/Engineer for layout of all work under this Section. Maintain all bench marks, control monuments and stakes as required for periodic verification of accuracy of construction.

2. If any discrepancies are found between the drawings and actual conditions at the site, Owner reserves the right to make minor adjustments in the work as necessary to accomplish the intent of the Contract Documents without increasing cost to the Owner.

1.5 JOB CONDITIONS

A. Existing Utilities

1. Some site utilities were installed during the previous sitework project, reference civil drawings for additional information. The Drawings do not show all known existing underground or concealed utilities in the vicinity of the Work and, the Owner cannot guarantee that all such lines, etc., are known. Where existing utilities not shown on the Drawings are encountered, support, shore up, and protect same, and immediately notify Owner. Allow access opportunity and ample time for measures necessary for continuance and/or relocation of such services. Refer also to the Conditions of the Contract.

2. If any discrepancies are found between the drawings and actual conditions at the site, Owner reserves the right to make minor adjustments in the work as necessary to accomplish the intent of the Contract Documents without increasing cost to the Owner.

3. Where noted on Drawings, cut and cap all street connections encountered in excavating along curb line and mark location so they can subsequently be located and reconnected as required.

B. Inspection

1. Examine the areas and conditions under which excavating, filling and grading are to be performed. Should any discrepancies between Drawings and Specifications and actual site conditions be encountered, consult Architect before commencement of work.

C. Erosion and Water Quality Control

1. Precautions shall be taken during the entire construction period to minimize wind and water erosion. Bare earth shall be kept moist to prevent wind erosion. Contractor is warned that wind is a problem in the area of construction and he must have means and methods covered in his bid to perform sprinkling to control dust and airborne particles. Bare earth shall be seeded or mulched well in advance of winter, rainy season, and/or freezing weather. Means and methods (Best Management Practices, defined by DOE) shall be provided by the Contractor to prevent sediment laden Run off from entering the adjacent properties, roads or waterways.

2. No work of this Section shall allow excavated material to flow into existing creeks, rivers, lakes, wetlands, ground waters, storm systems and cause contamination of same. Contractor shall develop a containment plan for use in performing work and obtain all necessary permits and provide all monitoring as required by the governing jurisdiction.

3. Accidental spills of petroleum products, solvents, toxic chemicals, fertilizers, and construction materials shall be cleaned up immediately. Wash water, chemical and petroleum wastes shall be contained and prevented from entering ground water or runoff into waterways and shall be properly disposed of.

4. Where required by the governing authority the Contractor shall secure a Construction Stormwater Permit and shall submit a Notice of Intent application, 60 days prior to discharging storm water and develop a Stormwater Pollution Prevention Plan (SWPPP) prior to breaking ground.

    i. The contractor shall designate an employee or other contracted individual to act as the person responsible for implementing and maintaining the permit requirements.

D. Protection of Persons and Property

1. All excavation or trenches near or under in-place footings or other improvements shall be cut in such manner so as not to undermine or reduce bearing for such improvements. All backfilling of such excavation shall be compacted to 95%

maximum density, as specified, without disturbing bearing, for, or integrity of, adjacent footings or improvements.

2. Barricade open excavations occurring as part of this work and post with signage and warning lights. Operate warning lights as recommended by authorities having jurisdiction. No open excavations shall be left uncovered adjacent to walking surfaces without direct supervision.

3. Refer to various other sections of this specification for additional requirements for capping, temporary re-routing, etc., of existing on-site utilities, irrigation lines, etc.

E. Protection of Existing Trees and Vegetation

1. Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, creaking, or skinning of roots, skinning and bruising of bark, etc.

F. Water and Frost

1. Keep earth under footings dry and free from frost. Should bearing surfaces be softened by water or frost, re-excavate to solid bearing and fill with 1,000 psi concrete.

2. Protect excavations from rain or water from any source during construction. Use suitable pumping equipment or other means as required by conditions. Continue pumping as necessary until completion of Project or until released by Owner.

3. When operations are interrupted by unfavorable weather conditions, prepare areas by grading and compaction to avoid ponding and erosion.

G. Trenching

1. Trenching for underground piping, electrical conduits, etc., done by the trade installing the pipes, conduits, etc., or others, shall conform to requirements of this Section. Backfilling of trenches shall conform to the requirements herein for 'Compacted Fill'. Provide 6" sand bedding and back fill with sand to 12" above spring line of pipe.

H. Cutting of Existing Pavements

1. Existing pavement surfaces shall be sawcut only to minimum width which will permit proper excavation and bracing of trenches, or other excavations. Exact locations of cuts shall be approved by the Owner in the field.

I. Replacing Pavements, Sidewalks and Curbs

1. All existing driveways, sidewalks, curbs or other paved or surfaced areas which are to remain shall be restored to their original condition as nearly as practical.

2. All replacement of surfaced areas shall be to the approval of the Architect.

3. If any pavement or surface area not immediately over or adjacent to a trench is disturbed or damaged as a result of operation of the Contractor, adequate repairs, as approve shall be made by the Contractor at his own expense.

J. Explosives

1. Do not bring explosives on site or use in work without prior written permission from authorities having jurisdiction. Contractor is solely responsible for handling, storage, and use of explosive materials when their use is permitted.

K. Cleaning and Surplus Material

1. Conduct work in an orderly manner and so as not to create nuisance. Dirt shall not be permitted to accumulate on streets or sidewalks nor to be washed into sewers.

2. Remove from the site and legally dispose of all debris and excavated material not approved for fills, including oversize rock. No rubbish or debris shall be buried on the site.

L. Unique Requirements of Operation

1. All pole support foundations must be supported on undisturbed medium dense or better soils as outlined in the geotechnical report.

2. All structural footings for bearing walls and retaining walls must be supported on undisturbed medium dense or better soils or on approved structural fill material as outlined in the geotechnical report.

PART 2 – PRODUCT

2.1 COMPACTED FILLS:

A. On-Site Backfill and Fill Materials

1. Approved suitable material from on-site excavation, or approved, imported, clean, granular material, free from organic matter and rocks or cobbles over 6" in diameter, and suitable for compaction, containing not more than 10% fines passing a 200 mesh screen.

B. Imported Fill

1. Clean, free-draining sand and gravel meeting the following requirements:

a. Granular mineral soil containing not more than 2% organic matter with granular content of 100% passing 3-1/2" mesh and not more than 10% passing #200 sieve.

C. Structural Fill

1. As outlined in the geotechnical report. Structural fill should consist of a good quality, granular soil, free of organics and other deleterious material and be well-graded to a maximum size of about 4 inches. If it will be placed in wet weather, all-weather fill material should be used and should contain no more than 5% fines (soil finer than U.S. No. 200 sieve, based on that fraction passing the U.S. ¾" sieve). The use of a 2" clean crushed rock (or equivalent) may be the most effective for the structural fill within this site depending on the prevailing weather conditions, and the time of year when earthwork is planned.

D. Pipe Bedding Fill

1. Approved, clean, washed bank run, or masonry type, 100% passing a 1/2" sieve, and not more than 2% passing a #20 sieve, or where prior approved, on-site soils free from organics, rocks and gravel.

2.2 DRAINAGE FILL

A. Drainage Course Fill (Capillary Break at slabs, etc.)

1. As outlined in the geotechnical report. Clean washed or screened, free-draining gravel (less than 3% by weight passing a U.S. sieve #200).

B. Sand

1. Approved, clean, washed bank run, or masonry type, 100% passing a 1/2" sieve, and not more than 2% passing a #20 sieve.

2.3 TOPSOIL

A. See Section 32 90 00 Plantings.

2.4 OTHER RELATED MATERIALS

A. Nonwoven Filter Fabric (at retaining wall)

1. Polypropylene geotextile fabric. Mirafi 160N non-woven geotextile fabric as manufactured by TenCate, or approved.

B. Foundation Drainage Piping

1. Minimum 4", if not detailed otherwise on Drawings, corrugated, perforated polyethylene flexible pipe, ABS or approved.

PART 3 - EXECUTION

3.1 EXCAVATION

A. **Excavation** consists of removal and disposal of material encountered when establishing required grade elevations, and includes removal and disposal of material of any classification

B. **Unauthorized Excavation** consists of removal of materials beyond indicated sub-grade elevations or dimensions without specific direction of the Architect. Unauthorized excavation, as well as remedial work directed by the Architect, shall be at the Contractor's expense.

1. Under footings or foundation base fill unauthorized excavation by extending the indicated bottom elevation of the footing or base to the excavation bottom, without altering require top elevation. Lean concrete fill may be use to bring elevations to proper position, when acceptable to the Architect.

2. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of the same classification, unless otherwise directed by the Architect.

C. Rock Excavation

1. Material to be excavated on this Project is assumed to be earth and other materials that can be removed by power shovel, bulldozer or other normal equipment to excavation work (but not requiring the use of explosives or drills), except for concrete items as may be encountered in demolition. If rock, as herein defined, is encountered within the limits of excavation, the Contract amount will be adjusted by Change Order. When the rock is encountered, the Contractor shall immediately notify the Architect and shall not proceed further until instructions are given and measurements made for the purpose of establishing volume of rock excavation. The Owner may adjust the grades should excessive rock be encountered in lieu of removing the rock.

2. Rock is defined as stone or hard shale in original ledge, or boulders, concrete or masonry masses over 2 cubic yards in volume, and (all of) which cannot be broken and removed by normal job equipment (power shovel, loaders, scoops, bulldozers) without the use of explosives or drills. This classification does not include materials such as loose rock, concrete or other materials that can be removed by means other than drilling and blasting or drilling and wedging, but which for reasons of economy in excavating, the Contractor prefers to remove by drilling and blasting.

3. Payment for rock excavation shall be at a mutually acceptable negotiated cost.

D. Additional Excavation

1. When excavation has reached required subgrade elevations, notify the Architect and Special Inspector who will make inspections of conditions.

2. If localized areas of unsuitable bearing materials other than those identified on the Drawings, or other unsuitable conditions not reasonably anticipatable from the soils reports and other information contained in the Contract Documents are

encountered at the specified subgrade elevations, the Architect will authorize the Contractor carry excavations deeper and replace the excavated material as directed.

3. Removal of such additional unsuitable material and its replacement as directed, will be paid for on the basis of unit bid prices and/or Contract Conditions pertaining to changes in the Work.

E. Stability of Excavations

1. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

3. All excavation which will in any manner affect the bearing capacity of the soil foundation to receive floor slabs, walls, columns, footings, pipe beds, and all external backfill under paved areas shall be performed so as not to disturb existing soils to remain.

F. Shoring and Bracing

1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.

2. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

G. Dewatering

1. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

2. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footing, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

3. Convey water removed from excavations and rain water to collecting or run-off areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary ditches.

H. Excavated Materials

1. Excavated material suitable for filling shall be transported to the proper location for placing or materials shall be stockpiled on the property at separate location from approved topsoil stockpiles until required for backfill and/or fill. Place, grade and shape stockpiles for proper drainage.

2. Locate and retain excavated materials away from edge of excavations while performing work in and around excavations.

I. Excavation for Structures

1. Excavate for footings to undisturbed natural bearing sub-soils containing no organic material and, in any case, not less than 1'0" below existing grade and sufficient to provide minimum depths below finished grades as indicated on Drawings.

2. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

3. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive concrete or gravel mat, structural fill or open-graded drain rock materials.

J. Excavation for Pavements

1. Excavate subgrade under pavements to comply with cross-sections, elevations and grades as shown.

K. Excavation for Trenches

1. Dig trenches to the uniform width required for the particular item to be installed, sufficiently wide to provide ample working room, and minimum 12" each side of items to be buried.

L. Cold Weather Protection

1. Protect excavations against freezing when atmospheric temperature is less than 35 degrees F. Remove or recompact frozen and/or thawed portions as required before backfilling or installation of materials.

3.2 FILLING

A. Ground Surface Preparation

1. Remove vegetation, brush, debris, unsatisfactory soil materials, obstructions and deleterious materials from ground surface prior to placement of fills.

2. When existing ground surface to receive fill has a density less than that specified under "Compaction" for the particular area classification, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to specified percentage of maximum density to a minimum depth of 6".

3. Do not bury wood, metals, plaster, gypsum wallboard or other construction debris. Remove such from site.

B. Placement and Compaction

1. Place backfill and fill materials in layers not more than 6" loose depth for material compacted by heavy compaction equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers.

2. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage of maximum density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen or contain frost or ice.

3. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately the same elevation in each lift.

4. Cobbles and boulders larger than 8" in diameter and broken inorganic rubble shall not be placed in compacted fills, except in "deep fills" as specifically authorized, directed and approved by Architect and Special Inspector.

5. Compact with extreme care against foundations and retaining walls so as not to damage or weaken walls due to excessive pressure or vibration.

C. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Inspection, testing, approval, and recording locations of underground utilities.

2. Removal of concrete formwork.

3. Removal of shoring and bracing, and backfilling of voids with satisfactory materials.

4. Removal of trash and debris.

5. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

D. Trench Backfilling

1. Shall conform to all applicable requirements of this Section as well as any additional requirements stipulated in sections covering work of trade for which trenching is required.

E. Fill `Under' Structures

1. Only imported granular fill material shall be used under structures and slabs unless specifically approved otherwise. Use natural on-site soils for fills at surfaced areas.

2. Type/compaction of fills designated for `under structures' shall extend laterally to an assumed bearing pressure line sloping downwards from a point at least 3'-0 outside the outermost edge of bearing surface at an angle no steeper than 40 degrees

F. Fill Behind Retaining Walls

1. Use Course Drainage Rock material for backfill unless otherwise detailed on Drawings.

G. Topsoil Fill

1. Areas indicated to be planting or grass areas and in accordance with PLANTINGS, Section 32 90 00, and as shown on Drawings

H. Interior Slab Drainage Course

1. Drainage course consists of placement of drainage fill material, in a layer of thickness indicated on Drawings over subgrade surface to support interior concrete slabs.

2. Place drainage fill material on prepared subgrade in layer of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting material during placement operations

3. Place vapor barrier over drainage course and then place sand bed, thickness as noted on drawings, on top of vapor barrier.

I. Exterior Drainage Course

1. At areas of concrete or pavement place drainage course to uniform thickness indicated on Drawings, graded to achieve drainage slopes indicated (or required).

3.3 COMPACTION

Control compaction during construction so that material is compacted to not less than the following percentage densities and according to the following standards, as applicable to the scheduled soil types:

A. ON-SITE NATURAL SOILS - IN ACCORDANCE WITH ASTM D-698:

1. Under Structures

a. Compact top 12" of subgrade and each layer of backfill or fill material to 95% maximum density.

2. Under Open-Graded Rock/Gravel Mat

    a. Surfaces to receive open-graded rock/gravel mat, shall be brought to optimum moisture content (+ 2%) and compacted in place to a minimum 90% of maximum dry density, to a depth of 12".

3. Under Building Interior Slabs

    a. Compact top 12" of subgrade and each layer of backfill or fill material to 95% maximum density.

4. At Lawn, Planting and Miscellaneous Unpaved Areas

    a. Compact top 6" of subgrade and each subsequent layer of backfill, fill material and/or topsoil to 85% maximum density, except top 6" surface layer which shall be placed loose and brought to final grade with minimum compaction.

        1) At existing areas to receive topsoil only, till existing subgrade to a depth of 6" before installing 6" (loose depth) topsoil.

5. Under Exterior Slabs and Walkways

    a. Compact top 6" of subgrade and each layer of backfill or fill material to 95% maximum density.

6. Under Vehicular Pavements

    a. Compact top 12" of subgrade and each layer of backfill or fill material to 95% maximum density.

B. IMPORTED (GRADED) GRANULAR MATERIAL - IN ACCORDANCE WITH ASTM D-1557 Compaction Test procedure:

1. Under Structures

    a. Compact top 12" of subgrade and each layer of backfill or fill material to 95% maximum density.

2. Under Open-Graded Rock/Gravel Mat

    a. Surfaces to receive open-graded rock/gravel mat, shall be brought to optimum moisture content (+ 2%) and compacted in place to a minimum 90% of maximum dry density, to a depth of 12".

3. Under Building Interior Slabs

    a. Compact top 12" of subgrade and each layer of backfill or fill material to 95% maximum density.

4. At Lawn, Planting and Miscellaneous Unpaved Areas

    a. Compact top 6" of subgrade and each subsequent layer of backfill, fill material and/or topsoil to 85% maximum density, except top 6" surface layer which shall be placed loose and brought to final grade with minimum compaction.

        1) At existing areas to receive topsoil only, till existing subgrade to a depth of 6" before installing 6" (loose depth) topsoil.

5. Under Exterior Slabs and Walkways

    a. Compact top 6" of subgrade and each layer of backfill or fill material to 95% maximum density.

6. Under Vehicular Pavements

    a. Compact top 12" of subgrade and each layer of backfill or fill material to 95% maximum density.

C. IMPORTED COARSE GRANULAR MATERIAL - IN ACCORDANCE WITH ASTM D4253-54 (Maximum Index Density) not conforming to the above standards for proctor test methods:

1. Under Structures

    a. Compact top 12" of subgrade and each layer of backfill or fill material to 70% relative density.

2. Under Building Interior Slabs

    a. Compact top 12" of subgrade and each layer of backfill or fill material to 70% relative density.

3. Under Exterior Walkways

    a. Compact top 6" of subgrade and each layer of backfill or fill material to 70% relative density.

4. Under Vehicular Pavements

    a. Compact top 12" of subgrade and each layer of backfill or fill material to 70% relative density.

3.4 GRADING

A. Uniformly grade areas within limits of Project, including perimeter transition areas, to achieve finish grade shown on Drawings and merge properly with existing grades to remain. Smooth finished surface within specified tolerances, with uniform levels or

slopes between points where elevations are shown, or between such points and existing grades.

B. Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes and as follows:

1. Lawn or Unpaved Areas

a. Finish areas to receive topsoil to within not more than 0.10' above or below the required subgrade elevations. Bring subgrades in lawn areas to elevations required to allow placement of 2" organic amendment in addition to topsoil.

2. Walks

a. Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 0.10' above or below the required subgrade elevation. Walks shall slope to drain as approved by Architect.

3. Pavements

a. Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 1/2" above or below the required subgrade elevation.

b. Sub-surface of fill under building slabs shall be graded smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2" when tested with a 10' straightedge.

c. Compact subgrade surfaces to the depth and percentage of maximum density for each area as specified herein before.

C. Proofing/Preparation at Non-Fill Areas

1. All non-fill areas to receive improvements shall be cleaned up, improved, compacted, and maintained as required, to achieve uniform subgrade conditions essentially equivalent to those specified above and as specified under 'COMPACTION', prior to placements of any improvements. Proof roll all subgrade surfaces (with 10 to 15 ton grid compactor or (minimum) 20,000 lb static weight. vibratory pad compactor) after compaction; excavate and fill (or dry out) any soft, spongy areas; remove all organic or extraneous matter on or near the surface; all as required and approved by the Architect/Engineer or Special Inspector. Maintain surface and subgrade in proper condition until improvements are in place.

D. Finish Grading and Topsoil

1. Spread topsoil to minimum depths indicated on the Drawings at planting or lawn areas, except where suitable topsoil exists and is indicated for improvement in place.

2. Grade and rake all topsoil finished surfaces smooth and free of debris and weeds to uniform slope and surfaces. Remove all surface rock over 1-1/2" largest dimension.

3. Machine dressing shall be supplemented by hand work to meet requirements outlined hereto the satisfaction of the Architect.

4. Upon completion of the cleaning and dressing, the Project shall appear uniform in all respects. All graded areas shall drain properly, be true to line and grade as indicated on the Drawings.

E. Maintenance

1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Sprinkling of the finish surface with water may be required to control wind erosion of the graded area.

2. Repair and re-establish grades in settled, eroded and rutted areas to specified tolerances.

3. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

END OF SECTION 31 20 00

NELSON GEOTECHNICAL
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September 24, 2021

Mr. Andy Miller
Eider Construction LLC
P.O. Box 139
Orondo, WA 98843
Via email: andy.miller@eiderbuilding.com

Geotechnical Engineering Evaluation
Eider Business Park
425 Ohme Garden Road
Wenatchee, Washington
NGA File No. 1297721

Dear Mr. Miller:

We are pleased to submit the attached report titled **"Geotechnical Engineering Evaluation – Eider Business Park – 425 Ohme Garden Road – Wenatchee, Washington".** This report summarizes our explorations of the surface and subsurface conditions within the site, and provides geotechnical recommendations for the proposed site development. Our services were completed in general accordance with the proposal signed by you on August 31, 2021.

The proposed business park project is located on the southeastern side of Ohme Gardens Road, and west of US 97A in the Wenatchee area of Chelan County, Washington. The Chelan County parcel number for the property is 232021140050. The property is irregular in shape, is currently open and undeveloped, and is bordered on two sides by existing developments on Ohme Gardens Road. Topographically, the development area is generally level within the majority of the property and rises up near the northwestern property boundary and Ohme Gardens Road to the north.

Three 5,200 square-foot pole buildings are proposed along the southeastern and northeastern sides of the property, in a relatively level, lower area. A truck parking area is planned near the irrigation easement that runs along the northwestern property boundary.

The subsurface conditions within the site were explored on September 3, 2021 with nine trackhoe-excavated test pits ranging from about 7.0 to 8.5 feet below existing grade. The soil conditions throughout most of the development area consisted of fill overlying native fine sand. The fill consisted of tan and brown sand with varying amounts of silt, gravel, and cobbles. The fill thickness encountered in our test pits ranged from about 2.5 to 6.8 feet deep. We did not encounter groundwater seepage in the test pits.

It is our opinion, from a geotechnical standpoint, that the planned development is generally feasible at the site provided that our recommendations are incorporated into project plans. We recommend that all foundation and slab-on-grade areas are underlain by six inches of crushed rock overlying medium dense or better native soils or structural fill extending to medium dense or better native soils. Recommendations for earthwork, cuts and structural fill, foundations, slabs-on-grade and pavements, as well as drainage and erosion control, are presented in the attached report.

We recommend that we review geotechnical aspects of the project plans prior to construction. We also recommend that NGA be retained to provide construction monitoring and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications.

We appreciate the opportunity to provide service to you on this project. Please contact us if you have any questions regarding this report or require further information.

Sincerely,

NELSON GEOTECHNICAL ASSOCIATES, INC.

Kenneth P. Cecil, PE
Senior Geotechnical Engineer

TABLE OF CONTENTS

LIST OF FIGURES

Geotechnical Engineering Evaluation
Eider Business Park
425 Ohme Garden Road
Wenatchee, Washington

INTRODUCTION

This report presents the results of our geotechnical engineering evaluation of the new Eider Business Park located on Ohme Gardens Road in Wenatchee, Washington, as shown on the Vicinity Map in Figure 1. The purpose of this study is to explore and characterize the site surface and subsurface conditions and to provide geotechnical engineering recommendations for the planned development. The development area is generally level within the majority of the property and rises up near the northwestern property boundary and Ohme Gardens Road to the north.

We understand that three 5,200 square-foot pole buildings are proposed along the southeastern and northeastern sides, in a relatively level, lower area. A truck parking area is planned near the irrigation easement that runs along the northwestern property boundary.

The purpose of this study is to explore and characterize the site surface and subsurface conditions, perform a geologic hazards assessment of the site, and provide our geotechnical opinions and recommendations for the project.

SCOPE

Based on our understanding of the planned development and site conditions, the services to be provided by NGA were to:

1. Review available soil and geologic maps of the area as well as other relevant geotechnical information, as provided.
2. Explore the subsurface soil and groundwater conditions within the site using trackhoe-excavated test pits.
3. Map the conditions on the site slopes using shallow, hand-tool explorations where necessary to construct geological cross sections.
4. Assess the site for potential geologic hazards, including landslide, seismic, erosion, avalanche, and flood hazards per Chelan County code.
5. Perform laboratory grain-size sieve analysis on soil samples, as necessary.

6. Provide recommendations for structure setbacks from geologic hazards, as necessary.

7. Provide recommendations for earthwork and foundation support.

8. Provide recommendations for retaining walls.

9. Provide recommendations for temporary and permanent slopes.

10. Provide recommendations for pavement support.

11. Provide general recommendations for site drainage and erosion control.

12. Document the results of our findings, conclusions, and recommendations in a written geotechnical report.

SITE CONDITIONS

Surface Conditions

The development area is generally level within the majority of the property and rises up near the northwestern property boundary and Ohme Gardens Road to the north. There is evidence of fluvial hillside erosion apparently caused by leaking water hoses from the bordering southwest property.

Subsurface Conditions

Geology: The geologic units for this area are mapped on the Geologic Map of the Wenatchee 1:100,000 Quadrangle, Central Washington, by R.W. Tabor et al., (USGS 1982). The proposed warehouse is in an area delineated as Columbia River Flood Deposits (Qtcl) [Pleistocene]. The Qtcl deposits are described as gravel with rounded clasts up to 12 inches and angular boulders up to 4.5 feet. These deposits are found in a discrete terrace about 150 feet above the Columbia River and display crude foreset beds dipping up the Wenatchee Valley.

Explorations: The subsurface conditions within the site were explored on September 3, 2021 with nine geotechnical test pits ranging from 3.0 to 11.0 feet below existing ground surface. The approximate locations of our explorations are shown on the Site Plan in Figure 2. A geologist from Nelson Geotechnical Associates, Inc. (NGA) was present during the explorations, examined the soils and geologic conditions encountered, obtained samples of the different soil types, and maintained logs of the test pits.

The soils were visually classified in general accordance with the Unified Soil Classification System, presented in Figure 6. The test pit logs are presented in Figures 7 through 9. We present a brief summary of the subsurface conditions in the following paragraph. For a detailed description of the subsurface conditions, the test pit logs should be reviewed.

The soil encountered in the planned development area consists of fill over native sand. The fill generally consists of fine sand with varying amounts of silt, gravel, and cobbles. Test Pit 2 encountered some concrete and plastic debris in the fill. Under the fill we typically encountered brown fine sand. Test Pit 6 encountered grey medium sand at the bottom of the test pit at 8 feet. The fill ranges in thickness from 2.5 feet to 6.8 feet. The fill appears to have been placed on prepared subgrade with some amount of compactive effort.

Hydrogeologic Conditions

We did not encounter groundwater seepage during our test pit explorations. During wet weather, a perched water condition may develop on this site. Perched water occurs when surface water infiltrates through less dense, more permeable soils and accumulates on top of underlying, less permeable soils. Perched water does not represent a regional groundwater "table" within the upper soil horizons. Perched water tends to vary spatially and is dependent upon the amount of rainfall. We would expect the amount of perched water to decrease during drier times of the year and increase during wetter periods.

GEOLOGIC HAZARDS

Seismic Hazard

Hazards associated with seismic activity include liquefaction and amplification of ground motion by soft deposits. Liquefaction is caused by a rise in pore pressures in a loose, fine sand deposit beneath the groundwater table. Based on surface observations during our site visit and our review of maps for the site area, the ground conditions at this site appear to consist primarily of sand.

We reviewed the Washington State Department of Natural Resources (WSDNR) Site Class Map of Chelan County, Washington (Palmer, et. al., Sept 2004) for seismic site classification for this project. Based on WSDNR mapping and the soil conditions encountered in our explorations, site conditions best fit the description for Site Class D.

We reviewed the WSDNR Liquefaction Susceptibility Map of Douglas County, Washington (Palmer, et. al., Sept 2004) for the liquefaction susceptibility for this project. Based on our experience in the area and the absence of groundwater in our explorations, it is our opinion that the on-site soils have a low potential for liquefaction.

Loose materials on slopes and undocumented fill have the potential for shallow sloughing failures during seismic events. Any undocumented fill or unvegetated soil on slopes should be expected to have an elevated potential for slope failures during seismic events.

Erosion Hazard

The criteria used for determining erosion hazard include soil type, slope gradient, vegetation cover, and groundwater conditions. The erosion sensitivity is related to vegetative cover and the specific surface soil types, which are related to the underlying geologic soil units. The Web Soil Survey by the Natural Resources Conservation Service (NRCS) was accessed on September 22, 2021 to determine the erosion hazard of the on-site soils. The surface soils at the site are mapped by NRCS as Cashmere sandy loam, 3 to 8 percent slopes (CaB). The CaB soils are described as having high capacity to transmit water and a slight water erosion hazard.

Landslide Hazard/Slope Stability

The criteria used for evaluating landslide hazards includes soil type, slope gradient, and groundwater conditions. Steep slopes are located off site to the northwest. These slopes do not show evidence of significant downslope movement. We did not observe evidence of deep-seated landslide activity. It is our opinion that the landslide hazard at the site is low.

Flood Hazard

We did not observe evidence of an active alluvial fan or recent flood deposits within this site. Accordingly, it is our opinion that the potential for catastrophic flooding, inundation, or debris flows in the project area should be considered low.

Snow Avalanche Hazard

No evidence or history of snow avalanches was observed within or nearby this site area at the time of our visit. The potential for avalanche is very low.

CONCLUSIONS AND RECOMMENDATIONS

General

It is our opinion from a geotechnical standpoint that the site is generally compatible with the planned warehouse development and construction. In general, our explorations indicate that the site is underlain by adequate fill soils over competent native sand.

We understand that the warehouse foundations will consist of posts embedded into the ground, likely about 4 to 6 feet deep. In general, we recommend that all warehouse foundations rest on competent fill or native bearing soils. If loose soil is encountered in the post excavations, we recommend the posts be deepened to competent soils. We recommend that all subgrades be evaluated by the geotechnical engineering consultant prior to placement of post concrete and slabs-on-grade. Specific recommendations for foundation design are included in the **Foundation Support** subsection of this report.

Within pavement and interior slab areas, the subgrade should be moisture conditioned, if necessary, and well compacted and the resulting subgrade should be proof-rolled with a heavy, rubber-tired piece of equipment. Areas observed to pump during the proof-roll test should be reworked to structural fill specifications or over-excavated and replaced with properly compacted structural fill, as defined in the **Structural Fill** subsection of this report. After the proof roll is complete, the pavement and slab-on-grade areas should be constructed as outlined in the **Pavement** and **Slab-on-Grade** subsections of this report.

We recommend that we review geotechnical aspects of the project plans prior to earthwork construction. We also recommend that NGA be retained to provide monitoring and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork activities comply with contract plans and specifications.

Erosion Control Measures

The erosion hazard for the on-site soils is generally considered slight for exposed soils but actual erosion potential will be dependent on how the site is graded and how water is allowed to concentrate. Best Management Practices (BMPs) should be used to control erosion. Areas disturbed during construction should be protected from erosion. Erosion control measures may include diverting surface water away from the stripped or disturbed areas. Silt fences should be erected to prevent material from leaving the site. Disturbed areas should be planted as soon as practical and the vegetation should be maintained until it is established. The erosion potential of areas not stripped of vegetation should be low.

Site Preparation and Grading

After erosion control measures are in place, site preparation should consist of stripping all organics or loose/soft soils to expose the medium dense or better soil in foundation and slab subgrade areas. The stripped material should be removed from the site or used within selected landscaping areas as approved. If debris, such as concrete, plastic, or other deleterious matter is exposed, it should be removed and hauled off site. In pavement areas, site preparation should consist of stripping all organics, loose/soft surficial soils, and unsuitable soils to expose competent subgrade. This surface should then be compacted and proof-rolled with a heavy rubber-tired piece of equipment. Prior to placement of any structural fill or crushed rock, NGA should be contacted to evaluate and approve exposed subgrades and provide recommendations for additional excavation and/or other subgrade improvements, if warranted. Areas observed to pump or weave during compaction should be reworked to structural fill specifications or over-excavated and replaced with properly compacted structural fill. If significant surface water flow is

encountered during construction, this flow should be diverted around areas to be developed and the exposed subgrade maintained in a semi-dry condition.

Temporary and Permanent Slopes

Temporary cut slope stability is a function of many factors, including the type and consistency of soils, depth of the cut, surcharge loads adjacent to the excavation, length of time a cut remains open, and the presence of surface water or groundwater. It is exceedingly difficult under these variable conditions to estimate a stable, temporary, cut slope angle. Therefore, it should be the responsibility of the contractor to maintain safe slope configurations since they are continuously at the job site and able to observe the soil and groundwater conditions encountered and able to monitor the nature and condition of the cut slopes.

The following information is provided solely for the benefit of the owner and other design consultants and should not be construed to imply that Nelson Geotechnical Associates, Inc. assumes responsibility for job site safety. Job site safety is the sole responsibility of the project contractor.

For planning purposes, we recommend that temporary cuts should be no steeper than 1.5 horizontal to 1.0 vertical (1.5H:1.0V). This should be specifically evaluated and approved by NGA at the time of construction. If significant groundwater seepage or surface water flow is encountered, we would expect that flatter inclinations may be necessary. If these inclinations cannot be met due to poor soil conditions, property line constraints and/or worker access issues, we recommend that shoring be considered for the planned cuts. We are available to provide recommendations for shoring, if needed, as the project plans are developed.

Permanent structural fill slopes should be no steeper than 2.0H:1.0V. Fill slopes should be compacted to structural fill specifications. Permanent slopes should be planted and the vegetation should be maintained until it is established.

We recommend that cut slopes be protected from erosion. The slope protection measures may include covering cut slopes with plastic sheeting and diverting surface runoff away from the top of cut slopes. We do not recommend vertical slopes for cuts deeper than four feet, if worker access is necessary. We recommend that cut slope heights and inclinations conform to appropriate OSHA/WISHA regulations.

Foundations

We recommend that the pole supports be founded in 18-inch minimum diameter concrete pier foundations supported on undisturbed medium dense or better soils. We also recommend that the piers be embedded a minimum of 2.0 feet below ground surface or 2.0 feet into the competent soils, whichever is deeper. Based on our explorations, we expect competent soil to be present near the ground surface. However, the depth to the competent soils may be deeper in unexplored areas of the site.

For conventional spread footings, we recommend the footings be supported on undisturbed medium dense or better soils or on structural fill extending to competent medium dense or better soils. We also recommend that spread footings be embedded a minimum 2.0 feet below ground surface for bearing and frost considerations.

Water should not be allowed to accumulate in pier excavations. All loose or disturbed soil should be removed from the pier excavation prior to placing concrete. For foundations constructed as outlined above, we recommend an allowable design bearing pressure of 1,500 pounds per square foot be used for determining the size and spacing of the pier supports. We should be retained to evaluate the foundation subgrade soils and embedment depths prior to placing foundation forms.

Lateral loads may be resisted by friction on the base of the footing and passive resistance against the subsurface portions of the foundation. A coefficient of friction of 0.30 may be used to calculate the base friction and should be applied to the vertical dead load only. Passive resistance may be calculated as a triangular equivalent fluid pressure distribution. An equivalent fluid density of 150 pounds per cubic foot (pcf) should be used for passive resistance design for a level ground surface adjacent to the piers. This level surface should extend a distance equal to at least three times the footing depth. These recommended values incorporate safety factors of 1.5 and 2.0 applied to the estimated ultimate values for frictional and passive resistance, respectively. To achieve this value of passive resistance, the foundations should be poured “neat” against the native medium dense soils or compacted fill should be used as backfill against the front of the footing. We recommend that the upper two feet of soil be neglected when calculating the passive resistance.

Retaining Walls

The lateral pressure acting on retaining walls is dependent on the nature and density of the soil behind the wall, the amount of lateral wall movement which can occur as backfill is placed, wall drainage conditions, and the inclination of the backfill. For walls that are free to yield at the top at least one thousandth of the height of the wall (active condition), soil pressures will be less than if movement is limited by such factors as wall stiffness or bracing (at-rest condition). We recommend that walls supporting horizontal backfill and not subjected to hydrostatic forces, be designed using a triangular earth pressure distribution equivalent to that exerted by a fluid with a density of 40 pcf for yielding (active condition) walls, and 60 pcf for non-yielding (at-rest condition) walls. A seismic design loading of 6H in psf should also be included in the wall design where "H" is the total height of the wall.

These recommended lateral earth pressures are for a drained granular backfill and are based on the assumption of a horizontal ground surface behind the wall for a distance of at least the subsurface height of the wall, and do not account for surcharge loads. Additional lateral earth pressures should be considered for surcharge loads acting adjacent to the walls and within a distance equal to the height of the wall. This would include the effects of surcharges such as traffic loads, floor slab loads, slopes, or other surface loads. We could consult with the structural engineer regarding additional loads on retaining walls during final design, if needed.

The lateral pressures on walls may be resisted by friction between the foundation and subgrade soil, and by passive resistance acting on the below-grade portion of the foundation. Recommendations for frictional and passive resistance to lateral loads are presented in the **Foundations** subsection of this report.

All wall backfill should be well compacted as outlined in the **Structural Fill** subsection of this report. Care should be taken to prevent the buildup of excess lateral soil pressures due to over-compaction of the wall backfill. This can be accomplished by placing wall backfill in 8-inch loose lifts and compacting the backfill with small, hand-operated compactors within a distance behind the wall equal to at least one-half the height of the wall. The thickness of the loose lifts should be reduced to accommodate the lower compactive energy of the hand-operated equipment. The recommended level of compaction should still be maintained.

Permanent drainage systems should be installed for retaining walls. Recommendations for these systems are found in the **Subsurface Drainage** subsection of this report. We recommend that we be retained to evaluate the proposed wall drain backfill material and observe installation of the drainage systems.

Final wall types will depend on final wall locations, heights, and budget. We could work with the designers regarding wall designs during the later stages of the project once plans have been developed.

Structural Fill

General: Fill placed beneath foundations, or other settlement-sensitive structures, and within the access areas should be placed as structural fill. Structural fill, by definition, is placed in accordance with prescribed methods and standards, and is monitored by an experienced geotechnical professional or soils technician. Field monitoring procedures would include the performance of a representative number of in-place density tests to document the attainment of the desired degree of relative compaction. The area to receive the fill should be suitably prepared as described in the **Site Preparation and Grading** subsection of this report prior to beginning fill placement.

Materials: Structural fill should consist of a good quality, granular soil, free of organics and other deleterious material and be well-graded to a maximum size of about four inches. If fill will be placed in wet weather, all-weather fill material should be used and should contain no more than five-percent fines (soil finer than U.S. No. 200 sieve, based on that fraction passing the U.S. 3/4-inch sieve). The use of 2-inch clean crushed rock (or equivalent) may be most effective for the structural fill within this site depending on the prevailing weather conditions, and the time of year when earthwork is planned. We should be retained to evaluate on-site material proposed for use as structural fill prior to construction.

Fill Placement: Following subgrade preparation, placement of structural fill may proceed. All fill placements should be accomplished in uniform lifts up to eight inches thick. Each lift should be spread evenly and be thoroughly compacted prior to placement of subsequent lifts. All structural fill should be compacted to a minimum of 95 percent of its maximum dry density, or as approved by the geotechnical consultant. Maximum dry density, in this report, refers to that density as determined by the ASTM D-1557 Compaction Test procedure. The moisture content of the soils to be compacted should be within about two percent of optimum so that a readily compactable condition exists. It may be necessary to over-excavate and remove wet soils in cases where drying to a compactable condition is not feasible. Water may need to be added and mixed into the soil to achieve adequate compaction if dry conditions exist during construction. All compaction should be performed by equipment suitable to attain the level of compaction required.

Slab-on-Grade

The slab subgrade area should be prepared as described in the **Site Preparation and Grading** subsection of this report. In general, we recommend that all floor slabs be underlain by at least six inches of free-draining gravel (less than 3 percent by weight passing the US sieve #200) for use as a capillary break and support for the slab. A suitable vapor barrier, such as heavy plastic sheeting (6-mil minimum), should be placed over the capillary break material. An additional 2-inch-thick moist sand layer may be used to cover the vapor barrier. This sand layer is optional and mainly intended to protect the vapor barrier membrane during construction.

Pavements

Pavement subgrade preparation, and structural filling where required, should be completed as recommended in the **Site Preparation and Grading** and **Structural Fill** subsections of this report. The pavement subgrade should be proof-rolled with a heavy, rubber-tired piece of equipment to identify soft or yielding areas that require repair. We should be retained to observe the proof rolling and recommend repairs prior to construction of hard surfaces.

In general, we recommend that the pavement section within light traffic and storage areas consist of 6 inches of 1¼-inch crushed rock (CSBC) overlain by 2 inches of hot mix asphalt (HMA). In heavy traffic areas (entrances and delivery truck isles) we recommend 8 inches of CSBC over 3 inches of HMA placed in two lifts.

Site Drainage

Surface Drainage: Water should not be allowed to collect in any area where footings are to be constructed. Final site grades should allow for drainage away from the structures. We suggest that the finished ground be sloped at a gradient of three percent minimum for a distance of at least 10 feet away from the structures and site slopes. Surface water should be collected by permanent catch basins and drain lines and be discharged to a suitable discharge point at the bottom of any slopes. Surface drains should be maintained separately and not be interconnected with foundation or wall drains. Runoff should not be allowed to flow uncontrollably over site slopes.

Subsurface Drainage: If groundwater seepage is encountered or if excessive surface water runoff occurs during construction, we recommend that the contractor slope the bottom of the excavations and direct the water to ditches and small sump pits. The collected water can then be pumped to a suitable discharge point.

We recommend the use of footing drains behind all retaining walls. Footing drains should be installed at least one foot below planned finished floor elevation. The drains should consist of a minimum 4-inch-diameter, rigid, slotted or perforated, PVC pipe surrounded by free-draining material wrapped in a filter fabric. We recommend that the free-draining material consist of an 18-inch-wide zone of clean (less than three-percent fines), granular material placed along the back of walls. Washed rock is an acceptable drain material, or drainage composite may be used instead. The free-draining material should extend up the wall to one foot below the finished surface. The top foot of soil should consist of low permeability soil placed over plastic sheeting or building paper to minimize the migration of surface water or fines into the footing drain. Footing drains should discharge into tightlines leading to an appropriate collection and discharge point and/or daylight with convenient cleanouts to prolong the useful life of the drains. Roof drains should not be connected to wall or footing drains.

USE OF THIS REPORT

NGA has prepared this report for Andy Miller with Eider Construction and his agents for use in the planning and design of the development planned on this site only. The scope of our work does not include services related to construction safety precautions and our recommendations are not intended to direct the contractors' methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design. There are possible variations in subsurface conditions between the explorations and also with time. Our report, conclusions, and interpretations should not be construed as a warranty of subsurface conditions. A contingency for unanticipated conditions should be included in the budget and schedule.

We recommend that NGA be retained to review project plans and consult with the design team during final design. We also recommend that NGA be retained to provide monitoring and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications. We should be contacted a minimum of one week prior to construction activities and could attend pre-construction meetings if requested.

Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time this report was prepared. No other warranty, expressed or implied, is made. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the owner.

o-o-o

We appreciate the opportunity to provide service to you on this project. If you have any questions or require further information, please call.

Sincerely,

NELSON GEOTECHNICAL ASSOCIATES, INC.

09/24/2021

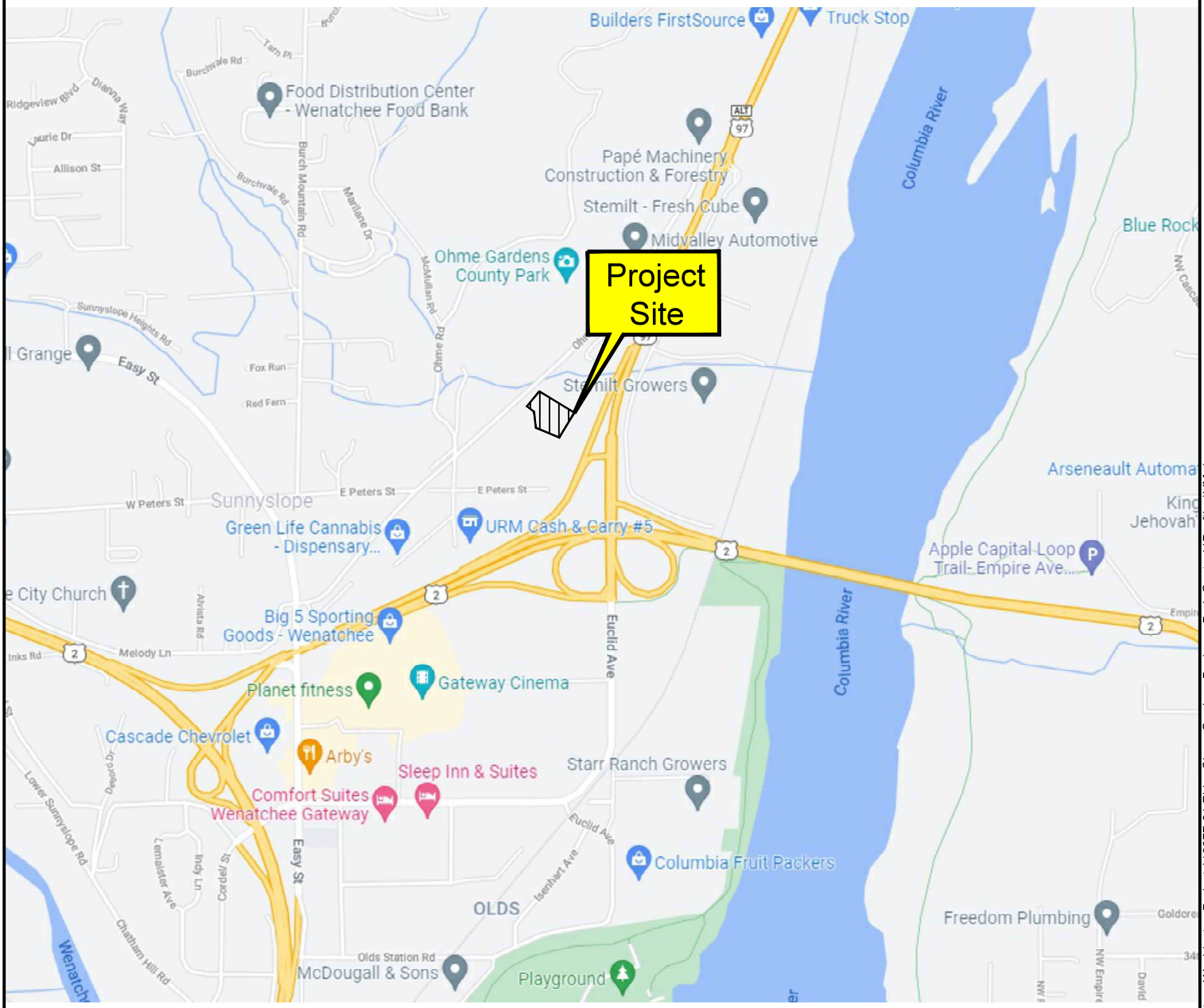
Kenneth P. Cecil, PE
Senior Geotechnical Engineer

CWG:KPC:sg

Nine Figures Attached

VICINITY MAP

Not to Scale



Wenatchee, WA

Project Number 1297721	Eider Business Park Development Vicinity Map	NELSON GEOTECHNICAL ASSOCIATES, INC	No.	Date	Revision	By	CK
Figure 1			1	9/17/21	Original	DPN	CWG

Woodinville Office
17311-135th Ave. NE, A-500
Woodinville, WA 98072
(425) 486-1669 / Fax: 481-2510

Wenatchee Office
105 Palouse St.
Wenatchee, WA 98801
(509) 665-7696 / Fax: 665-7692

www.nelsongeotech.com

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LEGEND

Property line

TP-1 — Number and approximate location of test pit

A A' — Approximate location of cross-section

0 60 120

Scale: 1 inch = 60 feet

Reference: Site Plan based on an undated plan titled "Design Site Plan Parcel #232021140150."

Project Number 1297721	Eider Business Park Development Site Plan	NELSON GEOTECHNICAL ASSOCIATES, INC
Figure 2		Woodinville Office: 17311-135th Ave. NE, A-500, Woodinville, WA 98072, (425) 486-1669 / Fax: 481-2510; Wenatchee Office: 105 Palouse St, Wenatchee, WA 98801, (509) 665-7696 / Fax: 665-7692; www.nelsongeotech.com

No.	Date	Revision	By	CK
1	9/17/21	Original	DPN	CWG
2	9/24/21	Rev 1	KPC	CWG

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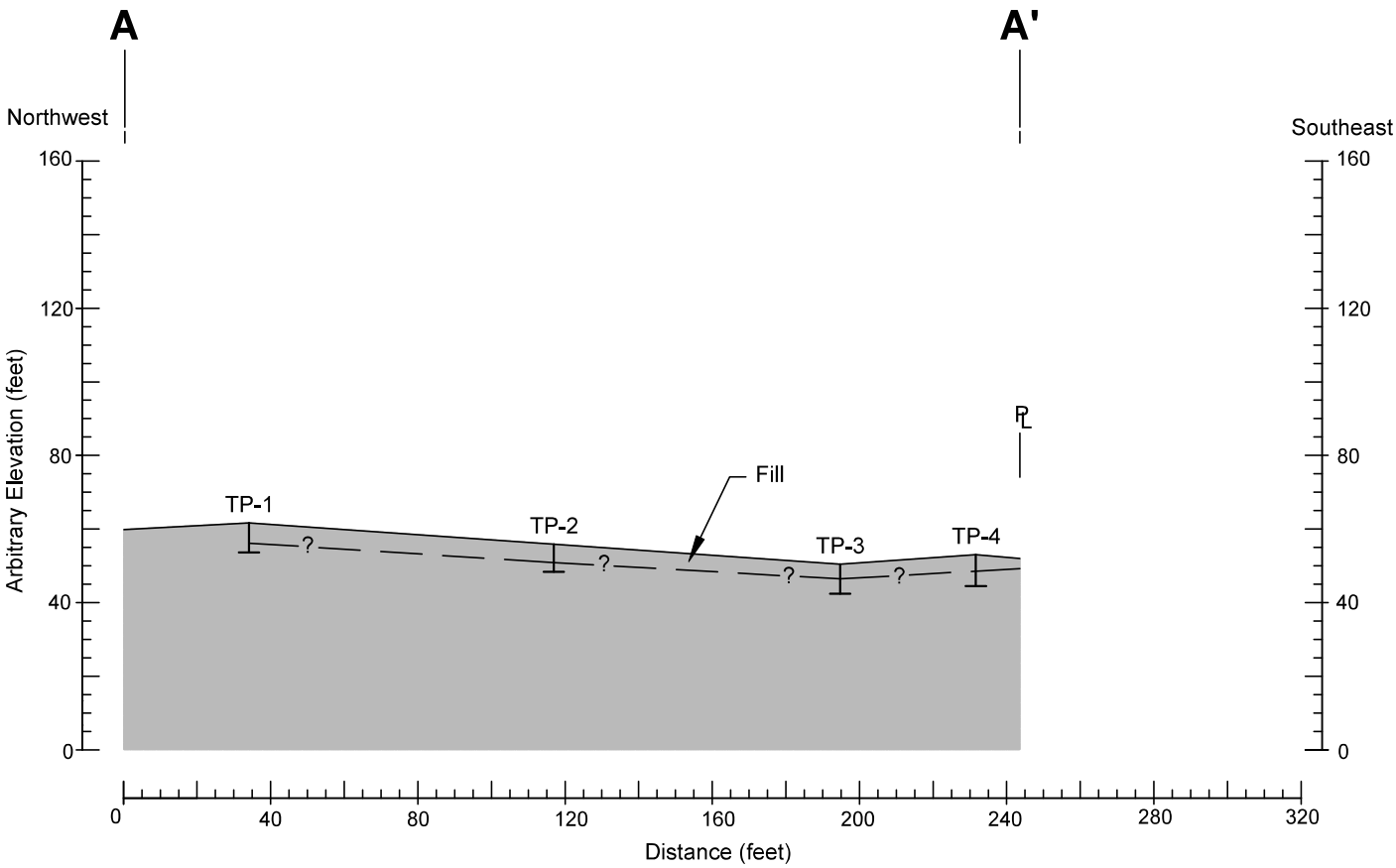
Project Number
1297721

Figure 3

Eider Business Park
Development
Cross-Section A-A'



Exploration

Test Pit Designation → TP-1

Groundwater Level During Exploration →

Geologic Contact (approximate) → ? — — ?

NOTES:
1) Stratigraphic conditions are interpolated between the explorations. Actual conditions may vary.
2) Elevations are arbitrary.

Reference: Cross Section is based on field measurements using a hand-held clinometer and 100-ft tape measure.

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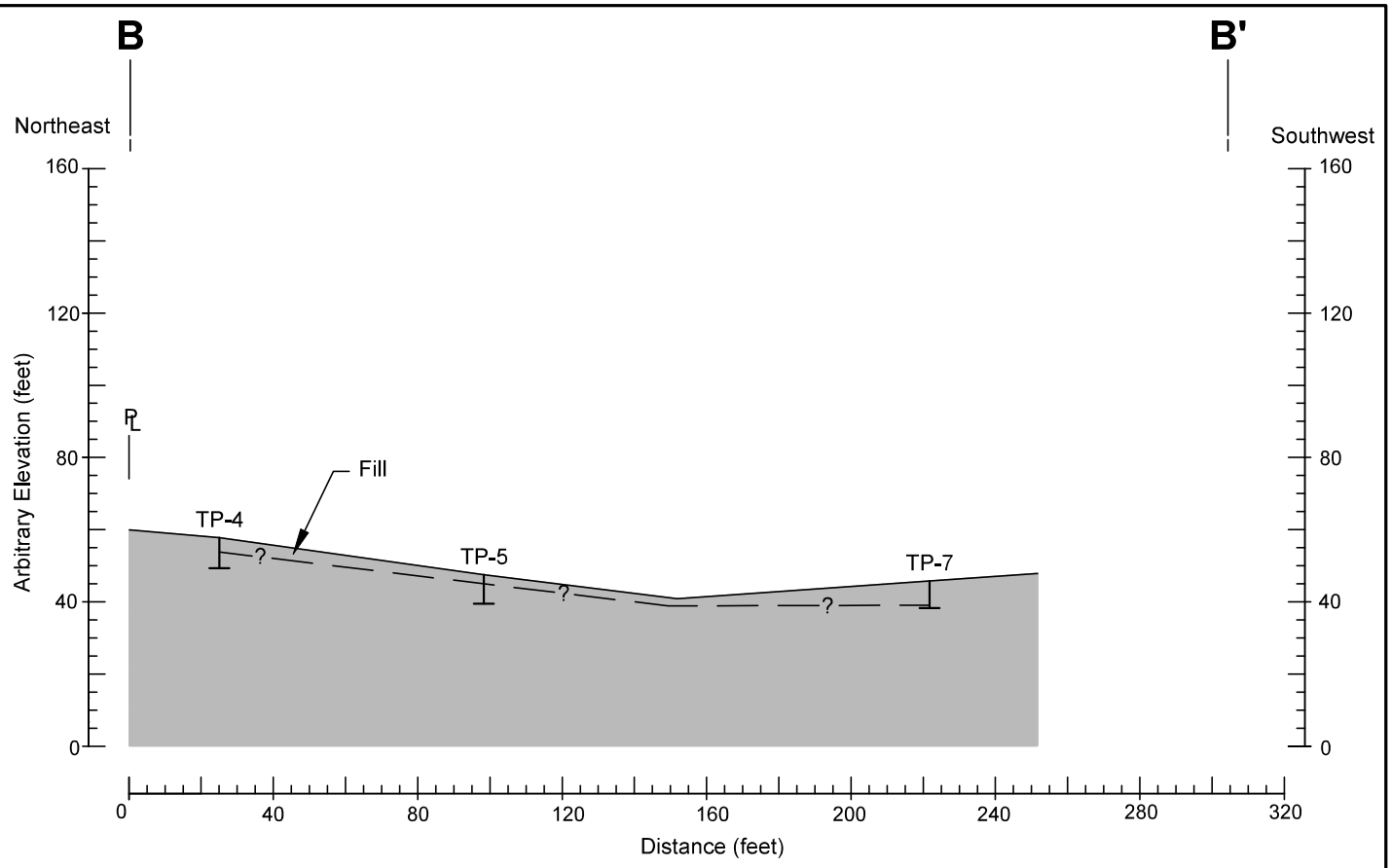
Project Number
1297721

Figure 4

Eider Business Park
Development
Cross-Section B-B'



Exploration

Test Pit Designation → TP-1

Groundwater Level During Exploration →

Geologic Contact (approximate) → ? — — ?

NOTES:
1) Stratigraphic conditions are interpolated between the explorations. Actual conditions may vary.
2) Elevations are arbitrary.

Reference: Cross Section is based on field measurements using a hand-held clinometer and 100-ft tape measure.

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No.	Date	Revision	By	CK
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Project Number
1297721

Figure 5

Eider Business Park
Development
Cross-Section C-C'

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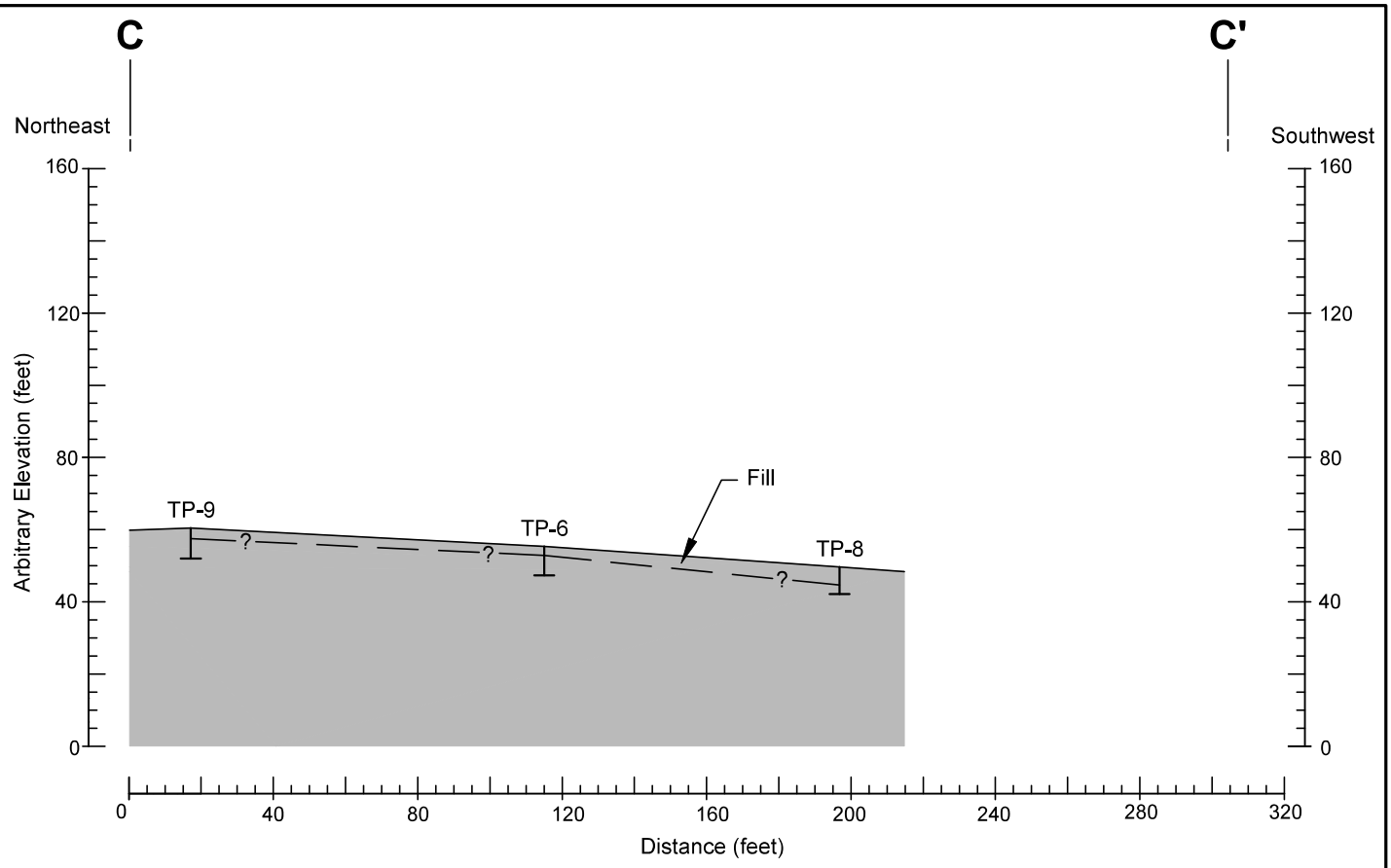
No.	Date	Revision	By	CK
1	9/17/21	Original	DPN	CWG



Exploration

Test Pit Designation → TP-1

Groundwater Level During Exploration →

Geologic Contact (approximate) → ? — — ?

NOTES:
1) Stratigraphic conditions are interpolated between the explorations. Actual conditions may vary.
2) Elevations are arbitrary.

Reference: Cross Section is based on field measurements using a hand-held clinometer and 100-ft tape measure.

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UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE - GRAINED SOILS MORE THAN 50 % RETAINED ON NO. 200 SIEVE	GRAVEL MORE THAN 50 % OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVEL	GW	WELL-GRADED, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND MORE THAN 50 % OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE - GRAINED SOILS MORE THAN 50 % PASSES NO. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50 %	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY LIQUID LIMIT 50 % OR MORE	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1) Field classification is based on visual examination of soil in general accordance with ASTM D 2488-93.
2) Soil classification using laboratory tests is based on ASTM D 2488-93.
3) Descriptions of soil density or consistency are based on interpretation of blowcount data, visual appearance of soils, and/or test data.

SOIL MOISTURE MODIFIERS:

Dry - Absence of moisture, dusty, dry to the touch

Moist - Damp, but no visible water.

Wet - Visible free water or saturated, usually soil is obtained from below water table

Project Number 1297721	Eider Business Park Development Soil Classification Chart	NELSON GEOTECHNICAL ASSOCIATES, INC	No.	Date	Revision	By	CK
Figure 6		Woodinville Office 17311-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 486-1669 / Fax: 481-2510 Wenatchee Office 105 Palouse St. Wenatchee, WA 98801 (509) 665-7696 / Fax: 665-7692 www.nelsongeotech.com	1	9/17/21	Original	DPN	CWG

LOG OF EXPLORATION

DEPTH (FEET)	USCS	BLOW COUNTS ASTM STP 399	SOIL DESCRIPTION
TEST PIT ONE			
0.0 – 1.0			TAN FINE SAND WITH SILT, GRAVEL, AND COBBLES (**FILL**)
1.0 – 5.5		9/12/10 AT 2.0 FT	TAN FINE SAND WITH SILT (**FILL**)
		18/18/22 AT 4.0 FT	
5.5 – 8.0	SP	12/13/15 AT 6.0 FT	BROWN FINE SAND (MOIST)
			NO SAMPLES WERE COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 8.0 FEET ON 9/3/2021
TEST PIT TWO			
0.0 – 2.0			TAN FINE SAND WITH SILT, GRAVEL, COBBLES, CONCRETE, AND PLASTIC (**FILL**)
2.0 – 5.0			BROWN FINE SAND WITH GRAVEL (**FILL**)
5.0 – 7.5	SP	13/15/16 AT 7.5 FT	BROWN FINE SAND (MOIST)
			NO SAMPLES WERE COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 7.5 FEET ON 9/3/2021
TEST PIT THREE			
0.0 – 2.0			TAN FINE SAND WITH SILT, GRAVEL, AND COBBLES (**FILL**)
2.0 – 4.0			BROWN FINE SAND WITH GRAVEL (**FILL**)
4.0 – 8.0	SP	13/13/19 AT 8.0 FT	BROWN FINE SAND (MOIST)
			NO SAMPLES WERE COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 8.0 FEET ON 9/3/21
TEST PIT FOUR			
0.0 – 0.3			GREY FINE SAND
0.3 – 2.0			TAN FINE SAND WITH SILT, GRAVEL, AND COBBLES (**FILL**)
2.0 – 4.0			BROWN FINE SAND WITH GRAVEL (**FILL**)
4.0 - 8.5	SP	14/20/26 AT 8.5 FT	BROWN FINE SAND (MOIST)
			NO SAMPLES WERE COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 8.5 FEET ON 9/3/21

LOG OF EXPLORATION

DEPTH (FEET)	USCS	BLOW COUNTS ASTM STP 399	SOIL DESCRIPTION
TEST PIT FIVE			
0.0 – 1.5			TAN FINE SAND WITH SILT AND GRAVEL (**FILL**)
1.5 – 2.5			BROWN FINE SAND WITH GRAVEL (**FILL**)
2.5 – 8.0	SP	12/22/30 AT 8.0 FT	BROWN FINE SAND (MOIST)
			NO SAMPLES WERE COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 8.0 FEET ON 9/3/21
TEST PIT SIX			
0.0 – 1.5			TAN FINE SAND WITH SILT AND GRAVEL (**FILL**))
1.5 – 2.5			BROWN FINE SAND WITH GRAVEL (**FILL**)
2.5 – 8.0	SP	14/20/26 AT 8.0 FT	BROWN FINE SAND (MOIST)
			GREY MEDIUM SAND AT 8.0 FT
			NO SAMPLES WERE COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 8.0 FEET ON 9/3/21
TEST PIT SEVEN			
0.0 – 0.5			TAN FINE SAND WITH SILT AND GRAVEL (**FILL**)
0.5 – 6.0			BROWN FINE SAND (MOIST) (**FILL**)
6.0 – 6.8			GREY MEDIUM SAND (MOIST) (**FILL**)
6.8 - 7.5	SP	10/13/14 AT 7.5 FT	BROWN FINE SAND (MOIST)
			NO SAMPLES WERE COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 7.5 FEET ON 9/3/21
TEST PIT EIGHT			
0.0 – 0.25			TAN FINE SAND WITH SILT AND GRAVEL (**FILL**)
0.25 – 4.0			BROWN FINE SAND (MOIST) (**FILL**)
4.0 – 5.0			GREY MEDIUM SAND (MOIST) (**FILL**)
5.0 - 7.0	SP	10/15/30 AT 7.0 FT	BROWN FINE SAND (MOIST)
			NO SAMPLES WERE COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 7.0 FEET ON 9/3/21

LOG OF EXPLORATION

DEPTH (FEET)	USCS	BLOW COUNTS ASTM STP 399	SOIL DESCRIPTION
TEST PIT NINE			
0.0 – 3.0			TAN FINE SAND WITH SILT AND GRAVEL (**FILL**)
3.5 – 7.0	SP	12/14/16 AT 7.0 FT	BROWN FINE SAND (MOIST)
			NO SAMPLES WERE COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 7.0 FEET ON 9/3/21

SECTION 32 10 00 – PAVING and SURFACING

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 STANDARDS

A. Standard Specification

1. Conform to "Standard Specifications for Road, Bridge and Municipal Construction", "Standard Plans for Road and Bridge Construction" and "Construction Manual", latest edition, published by the Washington State Department of Transportation as the Architect judges them applicable and modified herein and on the Drawings.

2. All references to measurement and payment are hereby deleted. All paving and surfacing work shall be under the lump sum price of the Basic Bid or in Alternates, as stipulated.

3. All references to the Engineer shall be interpreted to mean the Owner and/or Architect/Engineer.

B. Codes and Regulations

1. In addition to the Standard Specifications, comply with all other pertinent codes and regulations including, but not limited to the County or City having jurisdiction over the Project for driveways and other work done "off site" or in the public right-of-ways.

1.2 SUBMITTALS

A. Asphalt Mixing Plant

1. Plant shall be certified by the Washington State Department of Transportation and approved by Architect.

B. Evidence of Compliance

1. Submit a certificate from the mixing plant stating that paving material delivered to site conforms to these Specifications.

C. Guarantee

1. Soil treatment applicator shall guarantee that the treated areas under asphalt paving or crushed rock surfacing shall be free of any evidence of weed or vegetation growth for a period of 1 year.

1.3 QUALITY ASSURANCE

A. Protection

1. Use all means necessary to protect the installed work and materials of other trades; take special care in work adjacent to building. Should any defacement or damage occur, repair or replace as directed at no additional cost to the Owner.

B. Codes and Regulations

1. In addition to the Standard Specifications, comply with all other pertinent codes and regulations including, but not limited to the County or City having jurisdiction over the Project for driveways and other work done "off site" or in the public right-of-ways.

1.5 JOB CONDITIONS

A. Grades

1. Setting of grades shall be the sole responsibility of the Contractor. Establish grades to allow for proper drainage and finish surface, as indicated on the drawings. All areas shall drain with flow lines being free of depressions which permit water to stand.

PART 2 – PRODUCT

2.1 AGGREGATE:

A. Crushed Rock Aggregate

1. "Ballast", "Base Course", and "Top Course", as defined in Divisions 4 and 9, of the specified standards.

2.2 PAVING

A. Asphalt Concrete Mix

1. HMA Class 3/8" as defined in Standards, Section 5-04.

B. Asphalt

1. PG 64-28 type liquid asphalt binder as defined in Standards, Division 9.

C. Tack Coat (Bonding Oil)

1. Washington State DOT approved CSS-1 oil.

3.2 CONCRETE CURBS and BARRIERS

A. Concrete Curbs

1. Cement concrete curbs shall be constructed with air entrained concrete WSDOT Class 3000 conforming to the requirements of Section 6-02. Size and shape shall conform to details and WSDOT Standard Plan for Cement Concrete Traffic Curb.

Curbs shall be cast in place where noted on the drawings and where required to obtain specified radius.

i. Barrier Curb – Cement Concrete Traffic Curb (WSDOT Standard Plan F-10.12-00), w #4 rebar at the nose as detailed.

ii. Curb and Gutter – Cement Concrete Traffic Curb and Gutter (WSDOT Standard Plan F-10.12-00).

iii. Depressed Curb – Depressed Curb Section (WSDOT Standard Plan F-10.12-00). Provide with valley but no lip.

iv. Extruded Curb (6") – Type 6 Cement Concrete (WSDOT Standard plan F-10.42-00).

v. Extruded Curb (4") - Type 5 Cement Concrete (WSDOT Standard plan F-10.42-00).

2. Curbs shall be cast in place or extruded at Contractor's option.

2.4 OTHER RELATED MATERIALS

A. Soil Sterilant

1. Use Treflan E.C. by Dow AgroSciences, or any herbicide registered with the Washington State Department of Agriculture for use under pavements. Before use, submit the information required by WSDOT Standard Specification 5-04.3(4)B.

B. Bonding Agent

1. "Duraweld", or approved conforming to ASTM C494, Type A.

C. Striping Paint

1. WSDOT approved striping paint, white, unless otherwise noted.

D. Preformed Pavement Markings

1. "PreMark" as manufactured by Flint Trading Company. Crosswalks and ADA Access Aisle Lines and Accessibility Markings and as noted and detailed on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Soil Treatment

1. Apply sterilant to all areas to receive asphalt paving or crushed rock surfacing at a minimum rate of 20 lb. per 1,000 sf of surface, mixed with water or as recommended

by specific approved manufacturer, applied with a power spray after grading is completed.

2. Applicator shall be responsible for any run-off, contamination or damage caused by soil treatment product. Cost of damage to property or any neighboring property shall be the responsibility of the applicator.

B. Preparation

1. Subgrade conditions shall be proper and approved immediately prior to commencing paving operations. In no case shall paving or sub-course be placed over standing water or on soft, spongy areas of earth. Subgrade shall conform in all respects to requirements and conditions set forth in Section 31 20 00 and be graded smooth, uniform and true.

C. Concrete Curbs

1. Install curbs at locations shown and as detailed on the Drawings. Set curbs on prepared subgrade. Provide joints at 18' o.c. or as needed to align with every other parking stall stripe where occurring. Coordinate with cast in place concrete curb/gutter work as required and directed.

D. Asphalt Concrete Paving

1. Upon approval of subgrade and conditions, place sub-course and pavement materials in accordance with above cited Standard Specifications and best trade practice, to properly and uniformly achieve the following surface sections:

   a. (Entry Drives): 3" Asphalt Concrete Paving
      8" 1¼" Crushed Surfacing Base Course (CSBC)

   b. (Parking Areas): 3" Asphalt Concrete Paving
      8" 1¼" Crushed Surfacing Base Course (CSBC)

2. Compact asphalt mixture as soon as placing the mixture will bear a roller without undue displacement. Delays in rolling freshly spread mixture will not be permitted. The Contractor shall conduct preliminary tests of crown, grade, and smoothness and correct deficiencies. Compaction shall continue until a mat density of 92% Rice and a joint density of 92% Rice of laboratory compacted specimens of the same mixture is obtained.

E. Painting

1. Thoroughly clean the areas upon which striping and International Accessibility Parking Symbol will be placed. Apply the paint in strict accordance with manufacturer's published recommendations, using all means necessary to protect the painted surfaces until dry, 4" wide lines.

F. Preformed Pavement Markings

1. Clean and prepare existing asphalt for application of pavement markings at the International Accessibility Symbol, ADA Access Aisles and Crosswalks, and install per manufacturer's instructions in optimal weather conditions.

3.2 CORRECTION and CLEANING

A. Correction of Work

1. All paved areas shall have a finished surface without wrinkles or depressions.

2. All surfaces will be puddle tested before acceptance. Depressions exceeding 1/4" shall be corrected. All surfaces shall drain into area drains or catch basins or uniformly slope to form natural drainage as shown on Drawings. Repair and/or replace any paving which does not comply with the above which, due to uneven settlement occurring during the Contract Guarantee period, does not drain properly.

3. In the event of damage to paving materials or incorrect installation, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

B. Clean-up

1. Clean all surfaces of buildings, retaining walls, curbs, walks etc., soiled by the work under this Section immediately.

END OF SECTION 32 10 00

SECTION 32 30 00 – SITE IMPROVEMENTS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Provide all on-site improvements as indicated on the Drawings and not specified elsewhere.

1.2 SUBMITTALS

A. Within 30 days, provide manufacturer's standard material literature for Architect's review. Submit complete fabrication drawings for any item to be constructed specifically for this project.

1.3 JOB CONDITIONS

A. Deliver and store all items in protected areas until incorporated into the Work. Keep free from corrosion and damage. Replace any damaged items or parts at no costs to Owner.

PART 2 – PRODUCT

2.1 SITE WORK ACCESSORIES

A. Concrete Tire Bumpers

1. H2 Precast or equal standard pre-cast concrete bumper/curb, 5" high x 9" wide x 6' length. Provide with (2) #4 bars continuous, and (2) #5 x 10" pins.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install site improvement items as shown on Drawings and as required by governing agencies.

B. Coordinate locations of all items with grades, paving, utility, irrigation, landscaping layouts, etc., and details. Stake locations and orientations, and obtain approval from Architect.

C. Architect's approval of location does not relieve Contractor from responsibility for correct vertical and horizontal control and layout, and coordination of items such as drainage and water service lines, etc. Contractor shall relocate and reinstall items if conflicting with services. All site locations and furniture elements shall be a complete, working installation upon completion.

D. All items shall be square, plumb and oriented as approved by Architect. Mountings shall be as detailed and/or recommended by manufacturer.

END OF SECTION 32 30 00

SECTION 32 31 00 – CHAIN LINK FENCES and GATES

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 STANDARDS

A. Conform to the latest edition of Chain Link Fence Manufacturers Institute's Standards for Metallic Coated Steel Chain Link Fence and Fabric.

B. Conform to the State of Washington "Standard Specifications for Road, Bridge, and Municipal Construction" (WSDOT Standard Specifications) as the Architect judges them applicable and as modified herein and on the drawings.

1. All references to measurement and payment are hereby deleted. All fencing, gate and related work shall be under the lump sum price of the Basic Bid or in Alternates, as stipulated.

2. All references to the Engineer shall be interpreted to mean the Owner and/or Architect/Engineer.

1.2 SUBMITTALS

A. Within 30 days of Contract execution, and in accordance with all requirements of Division 1, submit the following:

1. Manufacturer's published literature for specified products and accessories. Submittal data shall include manufacturer's specifications, physical characteristics, performance data and instructions for installation.

2. Complete shop drawing showing dimensions, details, connections, locks, etc.

B. Certificate of Compliance

1. Submit notarized evidence satisfactory to the Architect that materials and finish conform to these Specifications.

1.3 QUALITY ASSURANCE

A. Coordination

1. Coordinate and cooperate with any other contractor or trade whose work relates in any way or who is on site at the time of work under this Section.

B. Inspection

1. Examine all of site to receive work under this Section and verify that all grades and lines are in proper condition to commence work of this Section. Notify Architect and allow for any corrections he may require. Do not proceed until improper

conditions are corrected. Commencement of work under this Section implies acceptance of conditions and Contractor shall be held responsible for correction of unacceptable conditions.

1.4 JOB CONDITIONS

A. All work to be included shall be completely installed and ready for use.

B. Verify all dimensions shown on Construction Drawings by taking field measurements and include on shop drawings.

C. Delivery and Storage

1. Deliver and store materials in a protected area. Keep free of damage and corrosion. Replace and/or repair any materials that have been damaged at no cost to the Owner.

PART 2 – PRODUCT

2.1 CHAIN LINK FENCING:

A. Manufacturer

1. Any manufacturer recognized by CLFMI and IFIA that can meet this Specification, Unless otherwise noted.

B. Conform to CLFMI standards for "Light Industrial/Standard Residential Fencing.

C. Fence

1. CLF-1 - 6' standard open fabric type (vertical):

a. Top rail and bottom wire.

b. 2 3/8" schedule 40 corner posts.

c. 1 7/8" schedule 40 intermediate posts.

d. Provide PVC slats, color as selected.

e. Footings: At intermediate posts 10" x 36" deep footings, at corner and gate posts 18" x 3'-6" deep footings.

2. CLF-2 - Standard open fabric type (vertical), infill wall openings as indicated on the Drawings:

a. Top rail and bottom wire.

b. 2 3/8" schedule 40 corner posts.

c. 1 7/8" schedule 40 intermediate posts.

d. Provide PVC slats, color as selected.

e. Footings: At intermediate posts 10" x 36" deep footings, at corner and gate posts 18" diameter x 3'-6" deep footings. At conflicts with concrete building footings, pour footing integral with building footing and sleeve w/ 4 ½" sleeve. Place post and grout in place.

3. CLF-3 – 8'-0 high overall, 6' chain link topped with 3 strands barb wire.

a. Fabric: 9 gauge galvanized 2" diamond shaped open fabric. Zinc coating of fence fabric shall be CLFMI Class 1, minimum 1.2 oz. per square foot of uncoated wire surface. Provide w/ 9 ga ties.

b. Intermediate Posts: 2 3/8" galvanized schedule 40.

c. Terminal and Corner Posts: 4" galvanized schedule 40, 9.11 lbs/lf.

d. Center Brace: 1 5/8" galvanized schedule 40.

e. Truss Rod: 3/8" dia galvanized steel rod, threaded one end. Swing Gate Posts: 4" galvanized schedule 40, 9.11 lbs/lf.

f. Provide PVC slats for CLF-3 adjacent to Building 4, color as selected.

g. Footings: At 2-3/8" posts, 10" x 36" deep footings, at 4" posts 18" diameter x 3'-6" deep footings.

h. Top and bottom tension wire: 7 ga galvanized wire. Bottom wire shall be no more than 1 1/2" above grade. Provide with tensioner

i. Barb wire: 3 strand 12.5 gauge steel wire with 14 gauge 4 point barbs spaced not more than 5" o.c., GBW (galvanized before weaving).

j. Barb wire supporting arms: Single 45 degree angle, 9 gauge, knuckled selvage conforming to ASTM F626, metal and finish to match fence frame work, with provision for anchorage to posts and attaching three rows of barbed wire to each arm. Arms shall be capable of withstanding 250 lb downward pull at outermost edge.

k. Provide all caps, bands, tension bars, wires, turnbuckles, fasteners, rebar, etc. as required for a complete and secure installation. Provide galvanized materials to match posts and fencing.

D. Swing Gates

1. Gates (Single):

a. Conform to CLFMI fabrication details, except as modified below.

b. Gate size shall be as noted on the plans.

c. Gates shall be of similar construction and materials to the fence section in which they are installed, unless specifically indicated otherwise.

d. Gate posts for panels shall be 2-3/8" O.D. pipe.

e. Provide welded construction for the configuration detailed in the drawings, including a cross brace, a brace bar above the gate, and frame extensions to accommodate hinges.

2. Swing Gate (Pair):

a. Conform to CLFMI fabrication details, and be of full fence height and widths called for on Drawings, and be provided with HD pivot hinges.

b. Gate size shall be as noted on plans.

c. Gates shall be of similar construction and materials to the fence section in which they are installed, unless specifically indicated otherwise.

d. Gate posts for panels less than 6'-0 shall be 4" O.D. pipe, 9.11#/lf. Posts for gates over 6' shall be 14.1#/lf.

e. Provide welded construction for the configuration detailed in the drawings, including a cross brace, a brace bar above the gate, and frame extensions to accommodate hinges.

f. Provide metal shield for gates at Building 4 to prevent access to padlock from outside of fenced area.

E. Swing Gate Hardware:

1. Gate Type G-1 (Single):

a. Gate Shield Kit: Lockey USA, PS3x1S24 Mounting Plate – Silver color, predrilled for lockset. Shop fit to gate width.

b. Lockset: Lockey USA Sumo GL2 keyless gate lock. Single combination, lever handle, satin chrome, marine grade.

c. Lockset Adapter: SUMO GL2LINX adapter for chain ling gates.

d. Closer: Lockey TB 250 Adjustable Hydraulic Gate Closer.

e. Latch Protector: Lockey USA, LPS Latch Protector – Silver color.

f. Gate Stop: Lockey USA, GSLINX 4" Gate Stop

g. Hinges: Bulldog pressed steel hinge, size for specified post and gate, or equal product by Lockinox.

2. Gate Type G-2 (Pair):

   a. Drop Rod.

   b. Drop U-latch with holed tang for padlocking. Provide locking device and padlock eyes as integral part of latch, permitting both gate latches with a single padlock.

   c. Hinges: Bulldog pressed steel hinge, size for specified post and gate, or equal product by Lockinox.

2.2 VEHICLE GATES

F. Cantilever Gate G-3

1. 28' opening electric gear operated sliding cantilever gate system, Heavy Duty Cantilever Slide Gate as manufactured by Tymetal Corp, 2549 SR 40, Greenwich NY 12834, 800-328-4283. Other manufacturers' products shall be prior approved by the architect before bidding.

2. Gate Frame - The gate frame shall be fabricated from 6063-T6 aluminum alloy extrusions. The top member shall be a 3" x 5" aluminum structural channel/tube extrusion weighing not less than 3 lbs/lf. Top frame member shall be "keyed" to interlock with the "keyed" track member. The bottom member shall be fabricated from a single piece of 2"x5" aluminum structural tubing weighing not less than 2.0 lbs/lf.

3. Vertical Members - The vertical members a the ends of the gate frame shall be "P" shaped in cross section with a nominal base dimension of no less than 2" x 2" and weighing not less than 1.6 lbs/lf. Major 2" x 2" vertical members shall weigh not less than 1.1 lbs/lf and shall separate each bay and shall be spaces at less than gate height intervals. Intermediate 1" x 2" vertical members weighing not less than .82 lbs/lf shall alternate between 2" x 2" major members.

4. Gate Track - The gate frame shall have a separate semi-enclosed "keyed" track, extruded from 6005A-T61 or 6105-T5 aluminum alloy, weighing not less than 2.9 lbs/lf. The track member is to be located on only one side of the top primary. Welds to be placed alternately along the top and sided of the track at 9" centers with welds being a minimum of 2" long.

5. Welds - All welds on the gate frame shall conform to Welding Procedure Specification and Procedure Qualification Record to ensure conformance to the AWS D1.2 Structural Welding Code. All individual welders shall be certified to AWS D1.2 welding code.

6. Gate Mounting - The gate frame is to be supported from the track by 2 swivel type, self aligning 4-wheeled, sealed lubricant, ball bearing truck assemblies. The bottom of each support post shall have a bracket equipped with a pair of 3" UHMW guide wheels. Wheel cover protectors shall be included with bottom guides to comply with

UL 325. Gap protectors shall be provided and installed, compliant with ASTM F 2200-05.

7. Diagonal Bracing - Diagonal "X" bracing of 3/16" or 1/4" diameter stainless steel cable shall be installed throughout the entire gate frame.

8. Gate Filler (Fabric) - 2" x 2" x 9 gauge aluminized steel chain link fabric shall extend the entire length of the gate. Counter balance shall also receive fabric. Fabric shall be attached at each end of the gate frame by standard fence industry tension bars and tie at each 2" x 2" vertical member with standard fence industry ties. Attachment method shall not leave leading or bottom edge protrusions.

9. Barb Wire - 3 strand barb wire and support arms shall be provided at the top of the gate.

10. Posts - two sets of support posts shall be minimum 4" o.d. round SS40. Gate posts shall be galvanized and supported in concrete footings. Concrete footings shall be set 3'6 deep and no less than 18" in diameter at the operator and gate posts.

11. Gate Height - Gates shall be 6' high with a height of 2" and in no case greater than 3" above finish grade.

12. Finish - Gate to be mill finish aluminum.

13. Accessories - Gate catcher and companion (top and bottom), ASTM F 2200 compliant protectors, vehicle detector loops, manufacturer's standard safety devices and reversing edge system.

14. Operator - TYM-VS2-1, 1 hp, 208V, 1 Phase, chain driven operator for gates up to 2,500 lbs. Operator shall be variable speed, adjustable up to 2 feet per second.

15. Control Interface - Operator shall be Controlled by Owner Furnished Owner Installed (OFOI) card reader and vehicle detector loops. Sequence of Operations:

    a. Gate to open with card reader to activate the gate to open then close after vehicle has passed thru.

    b. Gate to be programmable to be open at a schedule of days/times determined by the Owner.

    c. Gate to open and close from vehicle driving over the detector loops.

2.4 CONTROLS (Cantilever Gate)

A. Pedestal Mount

1. 58" Black Steel Pad Mount Pedestal. Model 58-9C-S with square black steel housing MC-CS-12-E as supplied by Goose Neck Stands.com or equal.

2.5 OTHER RELATED MATERIALS

A. Concrete

1. Posts, f'c = 2,000 psi.

2. Mounting Pads and Horizontal Slabs, f'c = 4,500 psi, w/ 6.5% air entrainment.

B. Paint

1. ZRC "Galvanite" metallic zinc coating or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Fencing, Gates and related components shall be installed by skilled craftsmen, supervised by fence manufacturer's representative, according to approved shop Drawings. Completed installation shall be rigid and in perfect alignment, plumb and true.

3.2 INSTALLATION

A. Fence

1. Top of fence shall be level with maximum distance between bottom of fencing material or bottom rail/tension wire and grade 1-1/2". Fence installations that are noted as allowed to slope uniformly with site must be installed with true line slope from point to point as noted with similar maximum space at bottom of fence as previously described. Varying lines, offsets, uneven slopes, etc., must be noted and approved on shop Drawings. If space below fence varies beyond maximum, Contractor shall be responsible for adjusting surface grades, whether new or existing, as directed to meet maximum space allowed.

2. Setting Fence

a. Excavate post holes and set posts in concrete per standard specifications, and as approved. Protect adjacent grade, etc., from damage of any type. If working over existing lawn or plantings, pile earth from excavation only on heavy plastic or fabric tarps, and carefully remove all excess excavated soil from improved areas of the site.

b. Stretch fabric tight, free from waves, buckles, and secure to frames.

3. Bracing Fence

a. At all terminal posts, corner posts and gate posts, provide center brace where top rail is not included and install truss rod diagonally from the top of one post to the bottom of the other, at corner posts, provide truss rod and center brace each side.

B. Swing Gates

1. Install gates per standard specifications and as required to operate smoothly.

    a. Install per WSDOT standards 8-12.3(2)O

2. Weld fabricated plates and tubes to gate as required for security and mounting of lock equipment. Grind all welds smooth and touch up with zinc rich paint, color to match frame.

    a. Obtain all lock information prior to fabrication and incorporate locking mechanism on gate shop drawings for approval.

    b. Size gate to allow for proper operation of the locking device at the latch side.

C. Locks

1. Coordinate lock with swing gates and fabrication details for hardware mounting plate.

2. Install per manufacturer's instructions

3. Coordinate locks with controllers and electrical requirements. Provide all conduit, wiring, etc as required for a complete and operating installation.

4. After installation, apply caulking to the lock enclosure for weatherproofing.

5. Adjust hardware for smooth operation.

D. Vehicle Gates

1. Install gate in conformance with manufacturer's installation instructions. Gate shall be installed complete with covers, pedestals, concrete mountings, etc. as required to provide a complete and operational system.

2. The gate supplier/installer shall review the Division 26 and 27 electrical requirements associate with this equipment and shall provide, under this section, any additional items required by the equipment specified under this section, to make a complete and operable system meeting all codes.

E. Controllers

1. Carefully review the manufacturer's written installation instructions and wiring diagrams prior to beginning work.

2. Coordinate all work with the appropriate locking device and any additional wiring or electrical components.

3. Provide all conduits, trenching, wiring, etc. as needed for a complete and operating system.

    a. Seal all openings in conduits, boxes, and penetrations for a watertight seal.

4. Program unit and instruct and review operation with Owner.

3.3 CLEAN UP and PATCHING

A. Grind all welds smooth where noted on drawings.

B. Paint all welds with zinc rich paint on fencing materials or, where occurring, coating to match adjacent materials and color.

C. Replace and Repair all disturbed surfaces and materials to original condition and as directed by the Architect/Owner.

D. Remove excess excavated material from site. Wasting on site allowed only by specific approval of Architect.

E. All oils, abrasives, dirt, etc., to be removed from fence and all parts in proper working order.

END OF SECTION 32 31 00

SECTION 32 80 10 – UNDERGROUND SPRINKLER SYSTEMS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 WORKMANSHIP

A. All workmanship shall conform to highest standards of trade practice; improper or careless work will be rejected.

1.2 SUBMITTALS

A. Within 30 days after award of the Contract, Contractor shall submit 5 copies of a complete listing of materials to be used on the Work accompanied by complete manufacturer's catalog submittals on all equipment (i.e., controller, valves, heads, etc.) Refer to Division 1.

B. Maintenance and Operating Instructions

1. Contractor shall provide complete maintenance and operating instructions for entire irrigation system as a part of the Project O & M Manuals. Assemble and submit 4 copies in accordance with provisions detailed in Division 1.

2. Contractor shall also conduct complete orientation and instruction session for authorized representatives of the Owner at time agreed upon after completion of the Work, and before final acceptance. Refer to Division 1.

C. Record Drawings

1. Record Drawings of the complete irrigation system shall be included in the Project Record Documents. Exact locations and depths of all underground lines, valves, drains, etc., shall be carefully recorded on Drawing set provided for this purpose, and checked, using project datum, monuments, and permanent improvements (buildings, fire hydrants, etc.) for reference, before backfilling proceeds, and before payment for installed work shall be made. Refer to Division 1 for format requirements, final submittal, etc.

1.2 SYSTEM DESIGN

A. Irrigation System shall be Contractor designed and reviewed/approved by the Architect/Owner. System shall conform to the specifications in all respects, and shall be designed so that it:

1. Provides independent service supply line and meter for irrigation

2. Provide water to all heads at a velocity not to exceed 5ft/sec.

3. Provides uniform, 3-way, head-to-head coverage of all areas scheduled to receive plantings, other than dryland grasses.

4. Applies water at a slow enough rate to avoid runoff erosion and puddling.

5. Provides sprinklers with matched precipitation rates for even coverage in each valve circuit.

6. Allows for one complete operating cycle throughout the entire project within a 12-hour operation time or less.

7. Provides for complete gravity drainage of system, without dependence on air pressure voiding.

B. Heads shall be of proper type for conditions, and shall be located so as not to be subject to damage from vehicles, snow removal or other causes. Any heads subject to possible vehicle traffic shall be served through triple swing joints. Spray heads on fixed risers may be used in large shrub masses, subject to the foregoing considerations.

1.4 JOB CONDITIONS

A. Layout and Grading

1. Layout and grading for proper drainage, etc., of the Work shall be solely the responsibility of the Contractor. The Owner and the Architect, through their field inspectors, may verify the Contractor's layouts and grades for their own records, but such verifications shall not relieve the Contractor of his responsibility for proper installation of the work in any case.

B. Use of System and Guarantee

1. The Contractor may use completed portions of the system for required watering during the term of the Contract and, at his option, may allow the Owner benefit of such watering; however, no such temporary use shall constitute or imply acceptance of those portions of the system by the Owner, and the contractual guarantee period shall date from the date of Substantial Completion, as defined, which, for the irrigation system, shall normally be only after all elements have been finally and properly completed, cleaned and adjusted, and the Owner has been fully instructed on proper operation and maintenance.

PART 2 – PRODUCT

2.1 IRRIGATION:

A. Piping

1. Service Piping

a. Galvanized pipe and fittings, threaded, schedule 40, ASTM 120, galvanized, with ANSI B 16.3 galvanized screwed fittings; **except** where main domestic water service is in plastic piping, irrigation service may be of same specification as main water service, as approved.

2. Irrigation Piping Mains and Manifolds

    a. All plastic pipe which is 2 ½" or smaller shall be Schedule 40 PVC and shall conform to ASTM D1785 – continuously and permanently marked with manufacturer's identification, type, class, nominal pipe size, schedule, and pressure rating (in psi) in accordance with the NSF standard.

    b. All main line pipe which is larger than 2 ½" in diameter shall be PVC 1120 or 1220 (SDR-PR) pipe, SDR-21 with a 200-psi pressure rating conforming to ASTM D3139.

    c. Provide pipes in 20-foot lengths, free of holes, blisters, wrinkles or dents. Except for drip irrigation systems, all systems are design to 100 psi. Pressure shall be regulated at source connection to operate at manufactures recommended pressure.

3. Line Location Tape shall be detectable irrigation line marking tape, Thorbrand or equal at all main and lateral lines.

4. Zone Piping

    a. Class 200 (160) PVC, conforming to ASTM Standard D2241, or Class 125 polyethylene pipe conforming to U.S. Commercial Standard CS 255-63, NSF approved.

    b. All PVC fittings shall be Schedule 40, ASTM D2466. Poly-pipe fittings shall match pipe products standard and utilize non-corroding metal clamping rings.

5. Risers

    a. All other risers shall be Schedule 80 PVC, dark grey in color, threaded both ends. Zone pipe to riser connections shall be (triple swing joints) made up with approved nylon or polyethylene street ells from female threaded adapter, and as detailed on Drawings. Minimum lever nipple length, 6" or as otherwise noted.

B. Valves

1. Manual Valves

    a. Unless otherwise scheduled on the Drawings, shall be American made, 125 psi bronze bodied gate valves with screwed bonnet, non-rising stem and solid disc. Mueller, or prior approved equal in all respects. Sizes as scheduled or noted on Drawings.

    b. Main shut-off and drain, and any other valves located too deep to be readily accessed by hand, shall be `curb stop' type with pivot blade handle, or standard ball valves with modified (blade type) handle for key access. Mueller `MKII Oriseal', or prior approved.

2. Drain Valves

a. Standard gate valves or angle pattern drain with cross handle. Champion Brass #200RS angle valve, or prior approved equal. Automatic drains not acceptable.

3. Backflow Check Valve

a. American made, bronze bodied double check valve with two non-rising stem, 150 psi gate valves, two 150 psi spring loaded check valves and four test cocks. FEBCO #805Y, or approved. Sizes as scheduled or noted on Drawings.

4. Pressure Reducing Valve

a. All bronze bodied, with integral union end connection and model screen strainer, 300 PSI, inlet rated. Wilkins #600 series, or approved.

5. Remote Control Valves

a. As scheduled on Drawings. Rain-bird, or approved equal, GFR plastic bodied, electric solenoid valves of "normally closed" type operation, with manual flow control.

6. Valve Keys

a. Furnish to Owner a minimum of (2) 'Tee-Handle' valve keys for each type of manual valve installed. Handle length equal to bury depth plus 2

C. Vaults and Valve Boxes

1. Plastic Valve Boxes

a. Plymouth "Ametek", "Jumbo" size, or approved, with latching lid and riser extension rings as required at control valves; standard 6" diameter x 12" high cones at drain valves. Color to match existing where occurring, or green where not otherwise specified.

2. CMU for Vault Construction

a. Standard weight concrete masonry units, 8x8x16 unless otherwise indicated.

b. UBC Type 'O' mortar.

3. Precast Vaults and Valve Boxes

a. Precast, reinforced concrete stacking vault sections, complete with precast top and cast iron frame and cover. "Fog Tite" Meter Seal Co., or equal. Size as required for proper installation and as detailed on Drawings.

D. Heads

1. Rotary Heads

a. Plastic bodied, impact type, as scheduled on Drawings. Pop-up type shall have HD plastic housing. Rainbird, or prior approved equal.

2. Fixed Spray Heads

a. Plastic nozzles (with integral strainers), on risers, as scheduled and located on Drawings. Rainbird, or prior approved equal.

3. Pop-up Spray Heads

a. Plastic nozzles (with integral strainers), in plastic bodies as scheduled and located on Drawings. 2" high pop-up unless otherwise noted. Rainbird, or prior approved.

4. Drip Emitters

a. Flow regulated 0.6 G.P.H., Katif by Plastro Irrigation, Inc. or as prior approved. Supply (10) extra emitters and 1 punch tool (Katif) to Owner.

E. Controller

1. Automatic Controller

a. As scheduled on Drawings. Rainbird or prior approved equal, with wall bracket or exterior posted cabinet, as required; mounted at the location(s) shown on the Drawings.

2. Control Wire

a. 24V direct burial (UF) wire. Size wire runs for length and static pressure per valve manufacturer's rating and instructions. Minimum wire size AWG #16, in any case.

2.2 OTHER RELATED MATERIALS

A. Sleeves

1. Provide Schedule 40 PVC pipe. Sizes as noted on the drawings, or required.

B. Thrust Block Concrete

1. f'c = 2,000 psi.

C. Pipe Bedding Material - approved, clean, washed bank run, or masonry type, 100% passing a 1/2" sieve, and not more than 2% passing a #20 sieve, or where prior approved, on site soils free from organics, rocks and gravel.

D. Gravel

1. Clean washed or screened, uniformly graded mixture of crushed stone or crushed or uncrushed gravel, graded as follows:

a.	Sieve	%		Passing Sieve
	1”	100%		
	3/4"	90%	-	100%
	#4	0%	-	25%
	#20	0%	-	5%

E. Filter Fabric

1. Polypropylene geotextile fabric. Mirafi 160 N non-woven geotextile fabric as manufactured by TenCate, or approved.

PART 3 - EXECUTION

3.1 LAYOUT and VERIFICATION

A. Check available static water pressure at points of system service connection and confirm to Architect (or Owner’s Representative) that pressure is adequate and proper for system design.

B. Layout all piping and heads as indicated on the Drawings and/or as approved. Plan Drawings are partially schematic and exact locations and detail of installation shall be adjusted to the particular site conditions as required and approved. Make minor adjustments as required to avoid plantings and other obstructions. Avoid damage to existing trees.

1. Intended minimum coverage is 100%. (Head-to-head spacing.) Stake out head locations and verify that proper coverage of plantings will be achieved before beginning pipe installation. Notify Architect of any problems or discrepancies and make required adjustments. If it is determined that additional heads are required, Contract Sum will be adjusted equitably.

2. Where parallel lines are indicated, more than one pipe may be placed in a trench provided proper and uniform separation and slope(s) are maintained, such that no line is interfering with access to, or maintenance of, the others. Refer to `Piping Installation' hereinbelow for detailed requirements.

C. Conform to all applicable requirements of Section 31 20 00, pipe trench details on Drawings, and as stipulated hereinbelow.

3.2 EXCAVATION

A. Excavate pipe trenches and pits for valves, drains and thrust blocks by mechanical and/or manual means conforming to best trade practices and allowing for proper conformance to all parts of these Specifications including uniformity of slope to drains, firm bedding, etc. Use all reasonable caution to avoid and minimize damage to, or disruption of, existing improvements and plants, utilities and work already in place. Repair any such damage or disruption at Contractor's expense and to Architect's satisfaction.

1. Maintain excavations free of rocks, debris, fluid mud and water.

2. **Minimum** cover shall be:

   a. Mains 12"

   b. Sub-Mains and Zone Piping: 8"

   c. Unsleeved Piping Under Vehicular Traffic Paving: 24"

   d. Sleeved Piping Under Vehicular Traffic Paving: 18"

3. Remove excavated rocks over 1-1/2" in diameter from soil before and during backfilling for at least the first 3" over pipe.

B. Pulling in of pipe allowed only by specific approval of each location, depending on conditions. No pulling of pipe will be allowed where any substantial amount of rock, cobbles or debris is present, or suspected.

1. If pulling is approved, use only bullet head vibratory puller. Pull only after final fine grading and use extreme care to maintain uniformity of depth and slope for drainage. Revise zone piping layout to utilize surface slope to low points as required and approved.

C. Backfill trenches and other excavations carefully and uniformly with approved on site material or approved imported fill per Section 31 20 00. Place no large rock or debris in backfill.

1. All fills over 4" wide and over 12" deep, shall be mechanically compacted to a minimum of 85% maximum soil density (AASHO T-180) in accordance with requirements of Section 31 20 00, to within 6" of finished grade.

2. All fills under areas to receive asphaltic pavement regardless of volume, shall be mechanically compacted to meet the minimum requirements set in Section 31 20 00.

3.3 INSTALLATION

A. Piping

1. Piping Under Paving

   a. All piping passing for a distance of 6' or greater under roads, curbs, walks and/or slabs that are a part of the work of this Contract shall be installed through pipe sleeves provided by contractor prior to placement of concrete or other paving.

      1) Additional sleeves shall be installed to accommodate future work, size and location as noted on plans. Mark ends of such sleeves with 2" steel Finder Pipe extending from bottom of sleeve to within 2" of finish grade, and leave nylon pull wire in sleeve for other to use in future.

2) Top of sleeve pipe shall be placed a minimum of 3" (4") below bottom of lowest concrete, including thickened edges, and a minimum of 12" below bottom of asphaltic paving, in any case, and shall allow for specified cover of piping. Dimension of sleeve pipe shall be at least 2" larger nominal dimension than pipe passing through it and shall extend a minimum of 9" past edges of pavement.

b. Where necessary, piping under in-place concrete where no sleeves are called for or installed, shall be placed by jacking, boring, or hydraulic driving, taking care not to weaken pavement bearing. Any pavement damaged or weakened by boring or driving pipe shall be replaced as directed by Architect, at Contractor's expense. No hydraulic driving permitted under asphaltic concrete paving.

c. Where any cutting or breaking of sidewalks and/or concrete work is necessary, cutting shall be done and paving replaced as part of the Contract cost. Permission to cut or break sidewalks and/or concrete must be obtained from the Architect, and strength, color, detail and finish of patch-back shall match existing to the Architect's satisfaction.

2. Place all pipe on firm trench bottoms, of rock free soil, uniformly sloped to drain points. Where filling of over-excavation is necessary, tamp fill firmly into place before laying pipe. "Sluff Bedding" as pipe is laid is not allowed. Installation of pipe in fluid mud or water is not allowed. Pipe passing over or past exposed rock shall be protected by at least 1-1/2" sand bedding.

a. Where parallel lines are indicated, more than one pipe may be placed in the trench provided a minimum separation of 3" horizontally is maintained between edges of piping, and in case of other services separation as required by specifications. Maintain the proper and uniform slope and install such that no line is interfering with access to, or maintenance of, the others. No crossing of pipes in trench, except as specifically approved.

b. Any bedding requirements shown or scheduled on the Drawings, or specified hereinafter, that exceed this minimum requirement shall govern.

3. Slope all piping uniformly to drains at all low points whether or not air pressure voiding of system is provided for.

4. Risers installed adjacent to building or retaining walls shall be located not less than 6", nor more than 12", from such wall, unless specifically shown or approved otherwise.

a. Length of risers shall vary with plant material type as indicated or directed. Generally, set shrub heads 8" to 12" above grade except as shown or directed otherwise. Set pop-up turf heads flush with compressed surface of established turf, or approximately 1/2" above finished seed bed.

5. All metal threaded connections shall be made up with pipe joint compound.

6. Protect plastic threads with teflon tape wherever metal heads or fittings are installed on PVC pipe.

7. Use (approved) compression couplings only where and as directed. No saddle tees allowed.

8. PVC slip connections shall be made up with solvent and adhesive, conforming to manufacturer's instructions. Clean plastic pipe frayings from all cuts before making up connection.

9. Polyethylene fitting connections shall be made carefully with insert properly fit, and rings tightly clamped.

10. Drain pockets of gravel with filter fabric laid at the bottom of the excavation shall be installed under all valve boxes.

B. Sleeves

1. Install PVC sleeves at locations indicated on the Drawings and at a depth of not less than 18", unless noted otherwise. Locate and mark ends of sleeves, leave nylon pull wire in sleeve for others to use in future.

C. Thrust Blocks

1. Install thrust blocks on all lines over 2-1/2" in diameter, at all horizontal tees, caps, all angular changes in direction of more than 20 degrees, (horizontal or vertical), and additionally as otherwise indicated on Drawings. Size thrust blocks as required to restrain any movement of pipe due to pressure surge or shock. 20" square minimum soil bearing area in any case.

D. Controls

1. Install temporary risers as necessary and thoroughly flush all lines to ensure that no dirt, debris, pipe frayings, etc., enter valves or heads, prior to control valve installation.

2. Control valve boxes occurring in lawn areas shall be set with tops flush with (2" to 3" below seed bed grade or 3" below) established turf surface. Boxes in planting areas shall be set with tops flush with finished soil grade.

3. Install all valves in plastic meter boxes specified above, as detailed on Drawings. Arrange to facilitate easy adjustment and removal. Provide union on upstream side of all valves. Use extension rings as required to bring lid to grade.

4. Multiple control wires shall be taped together at 4-foot intervals and wire bundle taped to bottom of supply line at 6-foot intervals.

5. Splices at valves shall be accomplished with L79C, A.M.C. Corp. device, or equal.

6. No splices in lead wire allowed between valve box and controller. Provide separate hot lead to each automatic valve. Common ground wire acceptable, conforming to valve manufacturer's wiring instructions.

7. Electrical wiring shall be installed according to local code and manufacturer's instructions. Location and mounting of controllers shall be as indicated on the Drawings, as proper for the conditions, and as approved prior to installation. A typewritten zone schedule shall be posted in controller to facilitate selection of valves to be operated.

3.2 SYSTEM PRESSURE TEST

A. With all valves closed, the irrigation system service and main piping shall be hydraulically static pressure tested at 150% of maximum available line pressure or 125 psi, whichever is higher; and shall show no more than a 5% drop in pressure over a 30-minute test period.

B. With all risers capped all zone piping shall be tested at maximum available line pressure or 100 psi, whichever is higher, and show no more than a 15% drop in pressure in a 10-minute test period.

C. Tests to be conducted by Contractor and witnessed by Architect or (Owner's Representative). Schedule tests with Architect a minimum of 48 hours in advance. All testing to be conducted at one session, except by special arrangement. Locate and repair all leaks encountered during testing. Retest until system is approved.

3.3 OPERATIONAL TESTING and ADJUSTMENTS

A. Lines shall be thoroughly purged, heads cleaned and adjusted to final grade and plantings as required and approved. Entire system shall be checked for proper coverage and operation over at least two complete cycles of zones in use. Owner and Architect reserve the right to require a reasonable number of nozzles and risers to be exchanged for alternate sizes and lengths in final adjustment of coverage. Remove, re-clean and re-install heads and nozzles as required. Replace defective heads and nozzles, if required.

B. Complete cycle tests shall include at least two different automatic start time settings on controller so that all controls shall be thoroughly checked for proper operation under typical operating conditions.

END OF SECTION 32 80 10

SECTION 32 90 00 – PLANTINGS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 – GENERAL

1.1 STANDARDS

A. The following standards, as applicable, shall govern planting work in general:

1. American Association of Nurserymen, "Horticultural Standards."

2. American Joint Committee on Horticultural Nomenclature, "Standardized Plant Names."

3. Association of Official Agricultural Chemists.

B. If discrepancy between the above standards and Specifications occurs, Specifications shall govern.

1.2 SUBMITTALS

A. Care and Maintenance Instructions

1. Contractor shall provide the Owner with written instructions on the Care and Maintenance of all landscaping installed under this Contract. Instructions shall be included in Project O & M Manual as detailed in Division 1 and shall include instructions on watering, rate and frequency, desirable soil moisture content, fertilizing, pruning, etc. Submit in strict accordance with requirements of Division 1.

B. Record Drawings

1. Contractor shall keep an accurately marked job set of drawings as the job progresses, with all changes or deviations from the original drawings covering the Work under this Section, in accordance with requirements of Division 1. Record the type of soil encountered in planting holes, size of hole where it deviates from specified size and record any utilities or unusual conditions or construction encountered in excavation.

C. Material Submittals

1. Topsoil

a. Submit (3) 1 lb. samples of topsoil proposed to be imported to site for (preliminary testing and) approval by the Architect. Approved samples will be used as the standard for acceptance or rejection of all soil actually imported.

2. Grass Seed ("No Mow Lawn")

a. Submit seed vendor's certified statement for each seed mixture required, stating botanical and common name, percentage by weight, and percentage of purity, germination, and weed seed for each grass seed species.

3. Fertilizer Content

a. Provide Architect/Engineer with a certificate issued by the vendor responsible for formulation of specified fertilizers, stating the contents and analysis of each shipment of fertilizer delivered to the site.

4. Organic Amendment

a. Submit (3) 1 lb. samples of material for testing and approval prior to ordering. Approved samples will serve as standard for acceptance or rejection of all material imported to site.

D. Guarantee and Replacement of Plantings

1. Plants shall be guaranteed for a minimum of 1 full year from the date of acceptance of planting. Replace at Contractor's expense, and as soon as the weather conditions permit, all plants not in a vigorous, thriving condition at the end of the guarantee period. The Contractor, however, will not be held responsible for the replacement of plants which are dead or otherwise unsatisfactory due to obvious vandalism, neglect or damage from causes beyond his control.

2. It shall be the Contractor's responsibility to inform himself that the Owner is following his recommendations for care and maintenance during the guarantee period and no release from guarantee shall be forthcoming unless he can prove conclusively that vandalism or failure to follow his recommendations was the cause of damage.

3. Contractor shall visit the site as often as he deems it necessary to observe the watering and other maintenance being conducted by the Owner. If he observes any condition detrimental to the normal germination of grass, or healthy development of other plants, he shall notify the Architect and the designated representative of Owner so that corrective measures can be taken.

4. Plants used for replacement shall be of same kind and size originally planted, shall be planted as specified, and carry the same 1-year guarantee.

PART 2 – PRODUCT

2.1 SOILS and AMENDMENTS

A. Imported Topsoil

1. Topsoil shall be clean, friable, natural sandy loam, containing a normal amount of decomposed organic matter and shall be free from heavy alkaline soil, chemical contaminants, coarse sand, stones, lumps, sticks or other foreign matter. Obtain Architect's approval of topsoil samples and source before beginning hauls, and

guarantee that all soil provided shall be reasonably uniform and true to approved samples.

B. Organic Amendment

1. Soil amendment shall be fine textured Fir, Hemlock or rotted Pine sawdust or bark dust. A 1 lb. sample from each 50 cubic yards imported to site shall be provided to the Architect for testing.

   a. Physical Properties

Percent Passing	Sieve Sizes	
95 - 100	6.35 mm	(1/4")
80 - 100	2.38 mm	(No. 8, 8 mesh)
0 - 30	500 micron	(No. 35, 32 mesh)

2. Chemical Properties:

   a. Nitrogen Content: 0.4 - 0.6% (dry weight basis)

   b. Iron Content: Minimum 0.08% dilute acid soluble Fe on dry weight basis.

   c. Soluble Salts: Maximum 3.5 millimhos/centimeter at 25 degrees C as determined by saturation extract method.

   d. Ash: 0 - 6.0% (dry weight basis)

C. Fertilizers

1. Fertilizers shall be of nationally recognized, reputable brands, delivered mixed as specified in standard size bags showing weight, analysis and name of the manufacturer. Store in waterproof storage place and in such a manner the effectiveness will not be impaired.

   a. General amendment fertilizer shall be certified 16-16-16 commercial fertilizer, or as approved.

   b. Organic amendment stabilization fertilizer shall be certified 38-0-0 "nitroform".

   c. Lawn fertilizer shall be certified 18-3-18 slow release commercial fertilizer and shall be a complete organic fertilizer with one-quarter of the nitrogen in the form of ammonia salts and one-half super phosphate, bone or tankage. The potash shall be in the form of sulphate of potash. The availability of various elements shall conform to the standards of the A.O.A.C.

   d. Tree and shrub planting fertilizer shall be certified 20-20-10 controlled release, or approved.

e. Gypsum shall be of nationally recognized reputable brand(s), manufactured finely ground for horticultural use and packaged in standard size D moisture proof bags.

D. Bark Mulch

1. Bark mulch shall consist of Douglas fir, pine, or hemlock bard, ground so that a minimum of 96 percent of the material will pass through a 1-1/2 inch sieve and no more than 55 percent, by loose volume, will pass through a 1/4-inch sieve. The bark mulch shall not contain resin, tannin, or other compounds in quantities that would be detrimental to plant life. Submit sample and source to Architect for approval prior to ordering and guarantee that all bark will be uniformly true to approved sample.

2.2 PLANTINGS

A. Grass Seed – No Mow Lawn Mix (Suncadia mix, or approved equal)

1. Grass Seed shall be labeled in accordance with provisions of the U.S. Department of Agriculture under Federal Seed Act in effect on the date of Invitation for Bids. All containers of seed shall be properly tagged bearing information as to variety of seed or seeds in the mixture, purity, germination, weed seed content, name of seller and date seed was tested. Provide only fresh, clean new crop seed. Seed which has become damaged or moldy in storage or transit will not be accepted. The seed mixture used for establishing vegetation on areas designated in these Plans and Specifications shall be composed of the following species, mixture, purity, germination and weed content tolerances:

a.

Kind of Seed	% Mixture	Min. Purity
Hard Fescue	40	95
Sheep Fescue	40	95
Canby Blue Grass	20	95

b. A guarantee statement of composition, purity, germination and weed content percentages shall accompany the seed and be provided to the Architect prior to seeding operations, and a copy included in the Care and Maintenance Manual(s).

B. Trees, Shrubs and Groundcovers

1. Plants shall be of genus, species and variety given in the Plant List. All plants shall be nursery or plantation grown under climatic conditions similar to those in the locality of the Project. Plants shall be healthy, vigorous and of normal habit and growth for the species. They shall be free from disease, insects, insect eggs and larvae and shall equal or exceed the size given in the Plant List. The specified sizes shall be before pruning and the plants shall not be pruned prior to delivery except upon special approval. Plant materials shall be symmetrical and/or typical for variety and species. See previous sub-section for guarantee and replacement of plantings.

a. Substitutions of plant materials will be considered only under terms and procedures set forth in Division 1.

b. Each plant shall be delivered to the site with certified nursery identification attached.

c. Plants shall be subject to inspection and approval upon delivery for quality, size and variety; such approval shall not impair the right of inspection and rejection at the site during progress of work for the size and condition of roots, latent defects, or injuries; nor shall failure of the Owner or Architect to reject material at this time in any way relieve the Contractor of his obligations under the guarantee provisions specified.

d. Rejected plants shall be removed immediately from the site. Certificates of inspection of plant materials shall be furnished as may be required by Federal, State or other authorities to accompany shipments.

e. In general, all plants shall be furnished balled and burlapped or in containers. Ball and container sizes shall conform strictly to AAN Standards. At his option, the Contractor may furnish deciduous trees bare root, the risk under guarantee being entirely his own.

f. No plant will be accepted when ball of earth surrounding roots has been cracked or broken prior to or during process of planting or when burlap, staves, ropes or platform have been removed. Protect balls from sun and wind by covering with soil, mulch or other suitable material if not planted immediately upon delivery.

g. The specified height and/or spread of all plant materials as indicated on Plant List shall be measured with branches in their normal position and from surface of ground when planted up to highest point of highest branch. Measure caliper of trees 6" above surface of ground when planted.

h. Quantities of plants shall be the Contractor's responsibility to determine per notations on the drawings. Where required quantities are determined by spacing only, indicated spacing shall be uniform and maximum in all directions. Spacing from edges of planting area to first (row of) plants shall be 3/4 of typical plant to plant spacing unless otherwise noted.

2. Staking Material

a. Materials shall be milled cedar or redwood of minimum sizes indicated on Drawings, free of knots and other defects that would impair strength.

PART 3 - EXECUTION

3.1 SOIL – PREPARATION and GRADING

A. Prior to placement/spreading of topsoil, any sub-grade surface that has become compacted or densified in the course of construction, shall be thoroughly tilled and

scarified as may be necessary to avoid stratification of soils and ensure consistent sub-surface drainage.

B. Topsoil utilized on the Work shall be the existing natural topsoil, stripped and respread as specified in Section 31 20 00, and/or approved topsoil imported to the Project as may be required to complete the Project or as indicated on the Drawings.

1. Where planting areas consist of existing undisturbed topsoil suitable and approved for use in the Work, kill out all existing vegetation with 'ROUND-UP' or other approved non-residual herbicide. After 5 days, till thoroughly to a minimum depth of 6", rake out and remove all weeds, roots and debris.

2. All existing on-site topsoil to receive plantings, whether stockpiled or approved in place, shall be uniformly improved with specified organic amendment in a uniform layer 2" thick, general amendment fertilizer and stabilization fertilizer, each at the rate of 10 lbs. per 1,000 sf and finely ground gypsum at the rate of 65 lbs. per 1,000 sf; all thoroughly tilled into top 6" of soil.

3. Improve imported topsoil with a uniform 2" layer of specified organic amendment, general amendment fertilizer and stabilization fertilizer, each at the rate of 10 lbs./1000 sf, all thoroughly tilled into top 6" of placed and graded soil.

4. After topsoil has been spread, improved and tilled, the area shall be lightly raked to remove all additional stones, roots, lumps or any other foreign matter and bring to final finish grade, as approved. The finished surface shall be loose, smooth, pulverized, and weed and grass free.

C. Grade of all finished planting areas before bark mulch shall, in general, be 1-1/2" lower than adjacent curb tops, slabs or sidewalks. Grade of lawn seed beds shall be 1" below adjacent curb tops, walks and slabs. Crown any areas surrounded by sidewalks or curbs to provide proper drainage and pleasing appearance. All surfaces adjacent to building or walls shall slope away from wall at a minimum slope of 1/2" in 1 foot, for a minimum distance of 4 feet, or until paving is met.

3.2 HYDROSEEDING

A. Time of Planting

1. The season for grass seed operations shall be at such times as are approved in writing by the Architect. The preparation work specified herein shall be timed so that it is complete at the beginning of the seeding season.

B. Bed Preparation

1. Place and grade out new or stockpiled/ respread (improved) topsoil to minimum depth and finish grades as indicated on Drawings.

a. Any undulations or irregularities in the surfacing which remain after first grading shall be dragged smooth. Hand rake to remove all clods, rocks, weeds, roots and debris of any kind. Re-till and re-grade any compacted or hard areas exposed

during finish grading so that entire bed area is thoroughly cultivated and improved topsoil at least 6" deep and brought to a uniform state of density.

2. After finish grade is established, apply specified fertilizer at the rate of 4-5 lbs. for every 1,000 sf and work the fertilizer lightly into the top 3" of the topsoil.

C. Seeding

1. Seed shall be sown by approved "Hydroseeding" methods with seed mixed into an approved, green colored, mulching compound, and applied at a rate sufficient to give a minimum seed coverage of 2 lbs./1,000 sf.

D. Rolling

1. If surface sowing is approved, after seeding, roll seed bed with 200 lb. roller to firm in the seed. Use irrigation systems or hand watering to keep proper moisture in soil at preceding stages of operation.

E. Initial Watering and Maintenance

1. After seeding, Contractor shall conduct initial watering of planting areas and shall maintain proper watering, protection and care until date of Substantial Completion under the Contract or until germination has been established, whichever is the later. Contractor shall notify Architect prior to completion of seeding and start of initial watering. During the germination period the Contractor shall maintain the seed bed reasonably free of weeds and pests and shall provide reasonably due protection from damage and vandalism and shall repair and reseed same, unless damage is so extensive so as to warrant a claim against the Owner's property insurance. On or before Substantial Completion, the Contractor shall provide, as a part of the Care and Maintenance Instruction Manual, written recommendations to the Owner relative to subsequent watering and care. Upon Substantial Completion, Owner will assume the responsibility for providing irrigation, weeding and protection from pests and vandalism.

F. Contractor shall remain responsible for reseeding all areas and spots larger than two feet in largest dimension which do not show a normal germination in 14 days. This reseeding shall be repeated, if necessary, until all areas show acceptable indication of being covered with grass.

G. Contractor shall remain responsible throughout the 1-year guarantee period for re-seeding all areas and spots larger than two feet in largest dimension which do not show a normal establishment and growth. This re-seeding shall be repeated, if necessary, until entire lawn area is covered with properly established grass.

3.3 TREES, SHRUBS and GROUNDCOVER PLANTING

A. Time of Planting

1. Plant all trees and shrubs as soon as site conditions and weather may allow.

B. Locations

1. Owner and Architect reserve the right to make reasonable on-site adjustments in location and orientation of all material at no additional cost to the Owner. If underground obstructions are encountered, alternate locations will be determined by the Architect. Notify Architect 48 hours prior to planting for location inspection.

C. Drainage, etc.

1. If clay, contaminated soil, or otherwise unsuitable soil/ drainage condition is encountered in digging any planting pocket, notify Architect and await instructions and Contract Sum adjustment agreement before proceeding. Planting of material constitutes acceptance of obligation under guarantee, as hereinbefore specified, by Contractor.

D. Tree Planting

1. All trees shall be planted in holes at least 2' greater in diameter than their ball of earth or natural bare root spread and providing for at least 6" of specified topsoil below the bottom of the ball or tree roots. Existing sub-soil excavated from planting pockets shall be removed from site unless specifically approved for mixing into topsoil backfill.

2. Trees furnished with root balls supported by wire baskets shall have baskets entirely removed, and disposed of off site, at time of planting.

3. Set tree in natural growing position and backfill around roots with mixture to topsoil and specified planting fertilizer at rate of 1 lb. of fertilizer per inch of caliper of tree. Refer also to details on Drawings.

4. Water and tamp thoroughly while backfilling to completely fill all voids around the roots. Leave a 1-1/2" deep watering basin around the base of the plant.

5. All small deciduous trees shall be supported by stakes as detailed on Drawings. Stakes shall be set before soil is backfilled, approximately 12" from the trunk and such that no roots are damaged.

6. All large trees and all evergreens over 6'0" high shall be guy-wired as detailed on Drawings.

E. Shrub Planting

1. All shrubs shall be planted in holes of at least 12" greater diameter than root ball, or spread, and allowing for a minimum of 4" topsoil below root ball or normal root depth. Existing sub-soil excavated from planting pocket shall be removed from site unless specifically approved for mixing with topsoil backfill.

2. Set shrub in its natural growing position and at the grade level at which it was originally grown. Backfill around roots with a mixture of topsoil as herein defined

thoroughly mixed with specified planting fertilizer at the rate of 1/4 lb. per shrub under 24" size and 1/2 lb. per shrub over 24".

3. Water and tamp thoroughly while backfilling to completely fill all voids around the roots. Form grade to provide a 1-1/2" deep watering basin around the base of the plant.

F. Groundcover Planting

1. Groundcover plants shall be carefully set into finished grade at spacings called for, with a minimum of disturbance after planting areas have been raked true to grade upon completion of tree and shrub planting and mulching.

G. Finish, Rake-Out and Mulching

1. Upon completion of tree and shrub planting, and prior to groundcover planting, all planting areas shall be carefully hand raked, removing all surface debris, large earth clods, etc., and brought to even and true finished grades called for.

2. Upon completion of final rake-out, all planting areas other than lawns and field grass shall be completely covered with specified commercial mulching bark to a minimum depth of 2"; 3" maximum.

3. Water plantings and clean up site as required by the General and Supplementary Conditions, before calling for final inspection. Hose down all walks and paved areas free of dirt or debris due to landscape work. Dirt and debris shall not be washed into storm drainage systems but shall be collected and removed from site.

3.4 CLEAN UP and WATERING

A. Water plantings and clean up site as required by the General and Supplementary Conditions, before calling for final inspection. Hose down all walks and paved areas free of dirt or debris due to landscape work. Dirt and debris shall not be washed into storm drainage systems but shall be collected and removed from site

END OF SECTION 32 90 00