

SKYWAY RESOURCE CENTER

Contract# SP2300150

12610 76th Ave Seattle, WA 98178

PROJECT MANUAL – VOLUME 1 FRONT END DOCUMENTS

Owner: King County Housing Authority



600 Andover Park W.
Tukwila, WA 98188

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PROJECT TEAM DIRECTORY**Owner**

King County Housing Authority
600 Andover Park W.
Tukwila, WA 98188
CONTACT: Sunnie Park
e. SunP@kcha.org
v. (206) 394.3757

Architect

Schemata Workshop
1720 12th Avenue
Seattle, WA 98122
CONTACT: Geoff Anderson, AIA
e. geoff@schemataworkshop.com
v. (206) 743.9437

Structural Engineer

Quantum Consulting Engineers, LLC
1511 Third Avenue, Suite 323
Seattle, WA 98101
CONTACT: Travis Michaud, PE, SE
e. tmichaud@quantumce.com
v. (206) 957.3917

Landscape Architect

Nakano Associates
3902 S Ferdinand St. #201
Seattle, WA 98118
CONTACT: Ida Ottesen, PLA, ASLA
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v. (206) 292.9392

MEPT Engineer

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600 Stewart St. Suite 1400
Seattle, WA 98101
CONTACT: Tom Marseille, PE
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Building Envelope Engineer

4EA Building Science
12721 30th Avenue NE, Second Floor
Seattle, WA 98125
CONTACT: Jeff Speert, AIA
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Cost Estimating

Rick Charbonneau Architectural Consulting
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v. (206) 795.9401

END OF SECTION

INVITATION TO BID

King County Housing Authority (KCHA) will accept bids from qualified general contractors to furnish labor, materials and necessary equipment to perform the following:

SCOPE OF WORK: This Project will bring the 1960's era building up to current codes and standards while improving the building envelope and other building systems. The existing bank building will be converted into a multi-resource community center for the Skyway neighborhood. The detailed work consists of: reconfiguring the building layout, partial demolition and abatement, building envelope improvements, build out of offices, new interior and exterior staircases, ADA lift installation, replacement of all interior fixtures and finishes including new plumbing, HVAC, and electrical, minimal site work around the parking lot, and other tasks as described in the bid documents.

PROJECT MANUAL DISTRIBUTION:

Address: King County Housing Authority, 600 Andover Park, Tukwila, WA 98188
Distribution: * Documents are available for download on KCHA's website at <http://www.kcha.org/business/construction/open/>

PRE-BID CONFERENCE:

Date and Time: Meeting 1: October 30, 2023 at 2:00 P.M.
Meeting 2: October 31, 2023 at 2:00 P.M.
Jobsite Address: 12610 76th Ave South, Seattle, WA 98178.
In Addition: Contractors are strongly encouraged to attend the Pre-Bid Conference. Failure to attend the Conference will not relieve the Contractor of any responsibility for information provided at that time.
For Questions: Questions pertaining to the bid are to be sent via email to nathank@kcha.org no later than seven (7) calendar days prior to bid due date. All responses shall be in the form of Addenda.
Posting: Addenda will be posted on KCHA's website.

BIDS ARE DUE:

Time: **2:00 PM**
Date: **November 17, 2023**
Address: King County Housing Authority
600 Andover Park West, Tukwila, WA 98188
Submittal Process: * Bids may be sent to Nate Kraus via mail, hand delivery, or by email to nathank@kcha.org. If dropping off a hard copy bid to the KCHA office, please make an appointment with Nate Kraus at nathank@kcha.org.
Process: All Bids must be received by KCHA no later than the above due date and time. No Bids will be accepted after that date and time.

BID GUARANTEE:

Amount: Five (5%) Percent of the Total bid must accompany Each Bid
Payable to: King County Housing Authority

PERFORMANCE AND PAYMENT BONDS: As a condition of award Performance and Payment bonds for 100% of the Contract Award Amount shall be furnished for the Work.

KCHA is an Equal Employment Opportunity Employer and strongly encourages minority-owned and women-owned businesses, socially and economically disadvantaged businesses, and small businesses to submit bids or to participate as subcontractors and suppliers on KCHA Contracts.

KCHA reserves the right to reject any or all bids or to waive any informality in the bidding. No bid shall be withdrawn for a period of 60 calendar days subsequent to the opening of the bids without the written consent of KCHA.

CONTACT PERSON: Nate Kraus at NathanK@kcha.org

INSTRUCTIONS TO BIDDERS

1.0 BIDDER RESPONSIBILITY CRITERIA

- A. It is the intent of Owner to award a contract to a responsible bidder submitting the lowest responsive bid. Before award, the bidder must meet the following bidder responsibility criteria to be considered a responsible bidder. The bidder may be required by the Owner to submit documentation demonstrating compliance with the criteria. The bidder must:
1. Have a current certificate of registration as a contractor in compliance with chapter 18.27 RCW, which must have been in effect at the time of bid submittal;
 2. Have a current Washington Unified Business Identifier (UBI) number;
 3. If applicable, have industrial insurance coverage for the bidder's employees working in Washington as required in Title 51 RCW; an employment security department number as required in Title 50 RCW; and a state excise tax registration number as required in Title 82 RCW;
 4. Not be disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065(3);
 5. Have received training on the requirements related to public works and prevailing wage under chapter 39.04.350 RCW and chapter 39.12 RCW or be listed as exempt by the department of labor and industries on its website; and
 6. Within the three-year period immediately preceding the date of the bid solicitation, not have been determined by a final and binding citation and notice of assessment issued by the department of labor and industries or through a civil judgment entered by a court of limited or general jurisdiction to have willfully violated, as defined in RCW 49.48.082, any provision of chapter 49.46, 49.48, or 49.52 RCW;
 7. Before award of a public works contract, a bidder shall submit to the contracting agency a signed statement in accordance with RCW 9A.72.085 verifying under penalty of perjury that the bidder is in compliance with the responsible bidder criteria requirement of subsection A, 6 of this section.

1.1 SUBCONTRACTOR RESPONSIBILITY

- A. The Contractor shall include the language of this section in each of its first tier subcontracts, and shall require each of its subcontractors to include the same language of this section in each of their subcontracts, adjusting only as necessary the terms used for the contracting parties. Upon request of the Owner, the Contractor shall promptly provide documentation to the Owner demonstrating that the subcontractor meets the subcontractor responsibility criteria below. The requirements of this section apply to all subcontractors regardless of tier.
- B. At the time of subcontract execution, the Contractor shall verify that each of its first tier subcontractors meets the following bidder responsibility criteria:
1. Have a current certificate of registration in compliance with chapter 18.27 RCW, which must have been in effect at the time of subcontract bid submittal;
 2. Have a current Washington Unified Business Identifier (UBI) number;
 3. If applicable, have:
 - a. Have Industrial Insurance (workers' compensation) coverage for the subcontractor's employees working in Washington, as required in Title 51 RCW;
 - b. A Washington Employment Security Department number, as required in Title 50 RCW;

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- c. A Washington Department of Revenue state excise tax registration number, as required in Title 82 RCW;
 - d. An electrical contractor license, if required by Chapter 19.28 RCW;
 - e. An elevator contractor license, if required by Chapter 70.87 RCW.
4. Not be disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065 (3);
 5. Have received training on the requirements related to public works and prevailing wage under chapter 39.04.350 RCW and chapter 39.12 RCW or be listed as exempt by the department of labor and industries on its website; and
 6. Within the three-year period immediately preceding the date of the bid solicitation, not have been determined by a final and binding citation and notice of assessment issued by the department of labor and industries or through a civil judgment entered by a court of limited or general jurisdiction to have willfully violated, as defined in RCW 49.48.082, any provision of chapter 49.46, 49.48, or 49.52 RCW.

1.2 SUPPLEMENTAL BIDDER RESPONSIBILITY CRITERIA

- A. RCW 39.04.350(2) specifically authorizes municipalities to adopt relevant supplement criteria for determining bidder responsibility applicable to a particular project which the bidder must meet.
- B. For the work in this project a responsible/qualified Bidder must meet the following standards:
 1. Have a current certificate of registration as a contractor, in compliance with chapter 18.27 RCW, for the last three years under the same business name;
 2. Have a good record of past performance that includes, but is not limited to, high quality work, ability to complete projects on time, contractor's integrity, compliance with public policy, financial, contractual and tax obligations, as well as Federal and State rules and regulations in performing construction contracts.
 3. Have a current Experience Modification Rate (EMR) of 1.0 or less, or an average EMR rate of 1.0 or less over the last three years. The requirement may, at the Owner's sole discretion, be waived on review of a written explanation that includes details of accidents, L&I records, a Loss Ratio Report for the last five years, costs, dates of events, and changes that have been made by the contractor to reduce accidents. A current company Safety Plan shall also be reviewed.
 4. Bidder shall provide evidence of previous successful completion of commercial rehab projects, of similar scope and complexity. Poor performance, lack of response, or failure to complete projects successfully within the contract time may be grounds for the rejection of bidder.
- C. Subcontractors shall have had three years minimum experience licensed in Washington State in the specific specialty contracting business.

1.3 PREPARATION OF BIDS – CONSTRUCTION

- A. Bids must be submitted on the Bid Form furnished by the Owner.
- B. All fields and questions on required forms must be fully answered and complete. Failure to do so may result in the bid being declared non-responsive.

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- C. The Bid shall comply with the following requirements:
 - 1. Pursuant to RCW 39.30.060, the Bidder shall provide names of the Subcontractors with whom the Bidder will subcontract for performance of heating, ventilation and air conditioning (HVAC), plumbing, and electrical.
 - 2. The Bidder can name itself for the performance of the work.
 - 3. The Bidder shall not list more than one Subcontractor for each category of work identified.
 - 4. Failure of the Bidder to list Subcontractors or to name itself to perform such work shall render the Bidder's bid nonresponsive and, therefore, void.
- D. Bidders shall acknowledge receipt of all addenda to this solicitation by inserting the addenda numbers in the space provided on the Bid Form. Failure to do so may result in the bid being declared non-responsive.
 - 1. Bidder is responsible for checking KCHA's website for addenda prior to submitting bid.
- E. In order for a bid to be considered responsive, bidders must submit the following signed documents with their bid package:
 - 1. Bid Form
 - 2. Bidder's Information Form
 - 3. Bid Guarantee
- F. The Bidder agrees to hold the base bid prices for sixty (60) days from date of bid opening.

1.4 BID GUARANTEE

- A. A bid guarantee in the amount of 5% of the base bid amount is required. Failure of the bidder to provide bid guarantee shall render the bid non-responsive.
- B. Acceptable forms of bid guarantee are: A bid bond or postal money order, or certified check or cashier's check made payable to King County Housing Authority.
- C. The Owner will return bid guarantees (other than bid bond) to unsuccessful bidders as soon as practicable, but not sooner than the execution of a contract with the successful bidder. The successful bidder's bid guarantee will be returned to the successful bidder with its official notice to proceed with the work of the contract.

1.5 AMENDMENTS TO INVITATION TO BID

- A. If this solicitation is amended, then all terms and conditions which are not modified remain unchanged.
- B. Bidders shall acknowledge receipt of all addenda to this solicitation by inserting the addenda numbers in the space provided on the Bid Form. Failure to do so may result in the bid being declared non-responsive.
 - 1. Bidder is responsible for checking KCHA's website for addenda prior to submitting bid.
 - 2. Addenda will not be issued later than three (3) calendar days before the deadline for receipt of Bids except Addendum withdrawing the request for Bids or extending the deadline for receipt of Bids.

INSTRUCTIONS TO BIDDERS

1.6 PRE-BID MEETING

- A. All potential bidders are strongly encouraged to attend. Oral statements may not be relied upon and will not be binding or legally effective.

1.7 EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE

- A. Before submitting a bid, the Bidder shall carefully examine each component of the Contract Documents prepared for the Work and any other available supporting data so as to be thoroughly familiar with all the requirements.
- B. The Bidder shall obtain copies of all agencies and associations guidelines and standards cited in the Contract Documents and necessary to perform the Work, including full size reproductions of material provided by Owner, at their own expense.
- C. The Bidder shall make a thorough and reasonable examination of the project site, facility and conditions under which the Work is to be performed, including but not limited to: Building access; resident occupancy; fire lanes; landscaping; obstacles and character of materials which may be encountered; traffic conditions; public and private utilities; the availability and cost of labor; and available facilities for transportation, handling, and storage of materials and equipment.

1.8 EXPLANATION TO PROSPECTIVE BIDDERS

- A. Any prospective bidder desiring an explanation or interpretation of the solicitation, drawings, specifications, etc., must submit a request in writing to the Owner seven (7) calendar days before the bid due date. Oral explanations or instructions given before the award of a contract will not be binding. Questions shall be submitted to:

Nate Kraus
King County Housing Authority
600 Andover Park W
Tukwila, WA 98188
Email: NathanK@kcha.org

1.9 PREVAILING WAGES

- A. Contractor shall pay no less than the Washington State Department of Labor and Industries (L&I) prevailing rate of wages to all workers, laborers, or mechanics employed in the performance of any part of the Work in accordance with RCW 39.12 and the rules and regulations of L&I. The schedule of prevailing wage rates for the locality or localities of the Work is determined by the Industrial Statistician of L&I. It is the Contractor's responsibility to verify the applicable prevailing wage rate.
 - 1. L&I prevailing wage rates may be found at <https://lni.wa.gov/licensing-permits/public-works-projects/prevailing-wage-rates/>
 - 2. The Owner has determined that the work meets the definition of commercial construction.
 - 3. The prevailing wage rates publication date is determined by the bid due date.
 - 4. The work is to be performed in King County.
 - 5. A copy of the prevailing wage rates is available at KCHA.

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6. A copy of the prevailing wage rates may be mailed on request.

1.10 TAXES

- A. All taxes imposed by law shall be included in the bid amount. The Contractor shall pay the WSST to the Department of Revenue and shall furnish proof of payment to the Owner if requested.
- B. The retail sales tax does not apply to the gross contract price.
- C. Prime and subcontractors are required to pay retail sales tax upon all purchases of materials, including prefabricated and precast items, equipment, leases or rentals of tools, consumables, and other tangible personal property which is installed, applied, attached, or otherwise incorporated in their work.

1.11 ASSURANCE OF COMPLETION

- A. Payment and performance bonds for 100% of the Contract Sum, including all Change Orders and taxes imposed by law, shall be furnished for the Work, and shall be in a form acceptable to the Owner.

1.12 BID ERROR

- A. In the event Bidder discovers an error in its bid, the Bidder may, under certain conditions and if before the date and time that bids are due, modify, their bid, as detailed below:
 1. Prior to Date and Time Bids are Due:
 - a. A Bidder may withdraw its bid at any time prior to the date and time bids are due upon written request.
 - b. After withdrawing an original submitted bid, a Bidder may modify and resubmit its bid at any time prior to the date and time bids are due.
 2. After the Date and Time Bids are Due:
 - a. A bidder who submits an erroneous low bid may withdraw the bid. The bid withdrawal is permissible if there was an obvious error in the low bid, and the mistake is readily apparent from the bid itself.
 - b. Notification: Provide to the Owner, within 24 hours of bid opening, written notification of the bidder's intent to withdraw the bid due to error.
 - c. Documentation: Provide to the Owner within 48 hours of bid opening, documentation sufficient in content to justify bid withdrawal to the satisfaction of the Owner. Include description and evidence of the error.
 - d. Approval: the Owner will approve or reject the request for withdrawal in writing.
 - e. Any low bidder who withdraws its bid is prohibited from bidding on the same project if it is subsequently re-solicited.

INSTRUCTIONS TO BIDDERS

1.13 ADDITIVE OR DEDUCTIVE BID ITEMS

- A. The low bid, for purposes of award, shall be the lowest responsive bid from a qualified responsible bidder offering the low aggregate amount for the base bid, plus additive or deductive bid alternates selected by the Owner.

1.14 BID EVALUATION

- A. Responsive Bids: A bid will be considered responsive if it meets the conditions of the solicitation, in addition to but not limited to the following requirements:
 - 1. Bid is received not later than the time and date specified.
 - 2. Bid is submitted in the proper format on the form(s) provided.
 - 3. Bid includes the complete scope of work as defined in bid package.
 - 4. Bid does not include any exclusions or qualifications.
 - 5. Bid includes Unit and Lump Sum Costs as listed in Proposal Form.
 - 6. Forms are complete.
- B. After bid opening, bids will be checked for correctness of bid item prices, extensions and the total bid price. Discrepancies shall be resolved by accepting the bid item prices and the corrected extensions and total bid price.
- C. Responsible Bidders: the Owner will award contracts only to responsible bidders who demonstrate the ability to successfully perform under the terms and conditions as set forth in the Contract Documents and have successfully completed projects similar in scope and complexity.
 - 1. Bidders must demonstrate relevant experience on similar types of projects and submit detailed information as required on the Bidder Information Form.
- D. The Owner reserves the right to contact references and investigate past performance and qualifications of the Bidder, subcontractor, and project team members, including contacting third parties and/or the references provided by the Bidder.
 - 1. The Owner may contact references for other projects including those the Bidder did not identify and/or provided references.
 - 2. References may be asked to rate the performance of and describe their experience with project team members and subcontractors. Bidder Information may be solicited and evaluated on the following subjects: type and features of work; overall quality of project performance and quality of work; experience and technical knowledge and competence of the Bidder and Project Team Members; ability, capacity and skill to perform the Work; ability to manage submittals, requests for information, prevailing wage filings, and other paperwork; compliance with laws, ordinances, and contract provisions; and other information as deemed necessary.
 - 3. Poor reference(s) may be justification to determine a Bidder is not responsible.
- E. At the Owner's request, provide any additional explanation or information, which would assist in evaluating the qualifications of the Bidder, subcontractors, project team members, and bid price.
- F. The Owner will verify information submitted and if the lowest bidder is determined to be “not responsible,” the Owner will issue, in writing, the specific reasons for this determination. The bidder may appeal this decision. The appeal must be in writing and shall be delivered to the

INSTRUCTIONS TO BIDDERS

Owner within two business days. The appeal may include additional information that was not included in the original bid documents. KCHA will make a final determination after the receipt of the appeal. The final determination may not be appealed.

1.15 CONTRACT AWARD

- A. Bonding and Insurance: Contract award will be contingent on ability to secure payment/performance bonding, and Contractor's ability to meet the Owner insurance requirements as detailed in the Bid Documents.
- B. Must, for the duration of the contract, procure and maintain Builders Risk insurance as stated in Part 2 of the General Conditions. This shall be in addition to General Liability, Automobile Liability, and Professional Liability/Errors and Omissions (if applicable) Coverage.
- C. Bonding, insurance certificate with endorsements, and an approved Statement of Intent to Pay Prevailing Wages shall be submitted to the Owner within 14 days of contract award. A Notice to Proceed shall be issued immediately after receipt.
- D. Right to Reject Bids/Waiver: The Owner reserves the right to reject any or all bids or to waive any informalities or irregularities in the bidding.
- E. Retainage Funds: The Owner will not pay interest to the Contractor for accounts where retainage funds are maintained by the Owner. As part of the procurement by which the Contractor was selected for this work, the Contractor agrees to waive any other options and has made allowances for this waiver.

GENERAL CONDITIONS

PART 1 - GENERAL PROVISIONS

1.1 DEFINITIONS

- A. "Authority Having Jurisdiction (AHJ)": A federal, state, local, or other regional department, or an individual such as a fire official, labor department, health department, building official, or other individual having statutory authority.
- B. "Contract Documents" means the Instructions to Bidders, Specifications, Plans, General Conditions, Prevailing Wage Rates, Bid Form, Contract Form, other Special Forms, Drawings and Specifications, and all Addenda and modifications thereof.
- C. "Contract Sum" is the total amount payable by Owner to Contractor for performance of the Work in accordance with the Contract Documents.
- D. "Contract Time" is the number of consecutive Days allotted in the Contract Documents for achieving completion of the Work.
- E. "Contracting Officer" means the person delegated the authority by King County Housing Authority to enter into, and/or terminate this Contract. The term includes any successor Contracting Officer and any duly authorized representative of the Contracting Officer.
- F. "Contractor" means the person or other entity entering into the Contract with King County Housing Authority to perform all of the services or work required under the Contract.
- G. "Day" means calendar day, unless otherwise specified.
- H. "Final Acceptance" means the acceptance by Owner that the Contractor has completed the requirements of the Contract Documents.
- I. "Final Completion" means the date when the Owner finds the Work acceptable under the Contract Documents and the Contract fully performed. The Owner will promptly notify the Contractor that to the best of the Owner's knowledge, information, and belief, and on the basis of the Owner's onsite visits and inspections. The Work has been completed in accordance with the Contract Documents and that the entire balance found to be due to the Contractor and noted in the final Application for Payment is due and payable.
- J. "Force Majeure" means those acts entitling Contractor to request an equitable adjustment in the Contract Time, including, but not limited to, unusually severe weather conditions which could not have been reasonably anticipated.
- K. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- L. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- M. "Liquidated Damages" means the amount prescribed in the Contract Documents to be deducted from any payments due or to become due Contractor, for each day's delay in completion of the Work beyond the time allowed in the Contract Documents as stated in the Notice to Proceed, plus any extensions of such time.
- N. "Manager" means the person who is an authorized agent of the King County Housing Authority to administer the Contract.
- O. "Notice to Proceed" means a notice from Owner to Contractor that defines the date on which the Contract Time begins to run.

GENERAL CONDITIONS

- P. "Owner" means the King County Housing Authority or its authorized representative with the authority to enter into, administer, and/or terminate the Work in accordance with the Contract Documents and make related determinations and findings.
- Q. "Property Manager" means the property management company, its officers and employees.
- R. "Provide": Furnish and install, complete and ready for the intended use.
- S. "Subcontract" means any contract, purchase order, or other purchase agreement, including modifications and change orders to the foregoing, entered into by a Subcontractor to furnish supplies, materials, equipment, and services for the performance of the prime Contract or a subcontract.
- T. "Subcontractor" means any supplier, vendor, or firm that furnishes supplies, materials, equipment, or services to or for the Contractor or another Subcontractor.
- U. "Substantial Completion" means 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.
- V. "Work" means the construction and services required by the Contract Documents, and includes, but is not limited to, labor, materials, supplies, equipment, services, permits, and the manufacture and fabrication of components, performed, furnished, or provided in accordance with the Contract Documents.

1.2 EXECUTION AND INTENT

- A. The intent of the Specifications and Drawings is to describe a complete Project to be constructed in accordance with the Contract Documents. Contractor shall furnish all labor, materials, equipment, tools, transportation, permits, and supplies, and perform the Work required in accordance with the Contract Documents.
- B. All work is to be executed in accordance with the Building Codes, as adopted by the Authority Having Jurisdiction, and other applicable codes and generally accepted industry standards. All products and materials are to be new and handled and applied in accordance with the manufacturer's recommendations.
- C. Contractor makes the following representations to Owner:
 - 1. The Contract Sum is reasonable compensation for the Work and the Contract Time is adequate for the performance of the Work, as represented by the Contract Documents;
 - 2. Contractor has carefully reviewed the Contract Documents, had an opportunity to visit and examine the Project site, has become familiar with the local conditions in which the Work is to be performed, and has satisfied itself as to the nature, location, character, quality and quantity of the Work, the labor, materials, equipment, goods, supplies, work, permits, services and other items to be furnished and all other requirements of the Contract Documents, as well as the surface and subsurface conditions and other matters that may be encountered at the Project site or affect performance of the Work or the cost or difficulty thereof.
- D. The Contract Documents are complementary. What is required by one part of the Contract Documents shall be binding as if required by all. Anything mentioned in the Specifications and not shown on the Drawings, or shown on the Drawings and not mentioned in the Specifications, shall be of like effect as if shown or mentioned in both. Note that some drawing sheets include specification information.

PART 2 - INSURANCE AND BONDS

2.1 INSURANCE REQUIREMENTS FOR BUILDING TRADES CONTRACTORS

GENERAL CONDITIONS

- A. Contractor shall procure and maintain for the duration of the contract insurance against claims for injuries to persons or damages to property that may arise from or in connection with the performance of the work hereunder by the Contractor, his agents, representatives, employees or Subcontractors.

2.2 MINIMUM SCOPE OF INSURANCE

- A. Contractors shall maintain coverages no less than:
1. Insurance Services Office Commercial General Liability and Excess Liability coverage including Products/Completed Operations.
 2. Insurance Services Office covering Automobile Liability, code 1 (any auto).
 3. Workers' Compensation insurance as required by State law and Employer's Liability Insurance.
 4. Builders Risk (Property / Course of Construction insurance covering for all risks of loss).

2.3 MINIMUM LIMITS OF INSURANCE

- A. Contractor shall maintain limits no less than:
1. General Liability: \$1,000,000 per occurrence for bodily injury, personal injury and property damage. If Commercial General Liability Insurance or other form with a general aggregate limit is used, either the general aggregate limit shall apply separately to this project/location or the general aggregate limit of \$2,000,000.
 2. Excess Liability / Umbrella Liability: \$5,000,000 per occurrence and per annual aggregate.
 3. Automobile Liability: \$1,000,000 per accident for bodily injury and property damage.
 4. Employer's Liability: \$1,000,000 per accident for bodily injury/sickness or disease.
 5. Builder Risk (Property) / Course of Construction: Completed value of project.

2.4 DEDUCTIBLES AND SELF INSURED RETENTION

- A. Any deductibles or self-insured retentions must be declared to and approved by the Owner. At the option of the Owner, either: the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects the Owner, its officers, officials, employees and volunteers; or the Contractor shall provide a financial guarantee satisfactory to the Owner guaranteeing payment of losses and related investigations, claim administration and defense expenses. **NOTE: If this contract deals with hazardous materials or activities (i.e. lead based paint, asbestos, armed security guards) additional provisions covering those exposures must be included in order to protect the Owner's interests.**

2.5 OTHER INSURANCE PROVISIONS

- A. The policies are to contain, or be endorsed to contain, the following provisions:
1. The Owner, the Property Manager, its officers, officials, employees, partners, agents and volunteers are to be covered as additional insureds under a "completed operations" type of additional insured endorsement with respect to general liability arising out of work or operations performed by or on behalf of the Contractor including materials, parts or equipment furnished in connection with such work or operations. The endorsement(s) effectuating the foregoing additional insured coverage shall be ISO form CG 20 10 11 85, or CG 20 10 10 01 issued concurrently with CG 20 37 10 01, or their equivalent as long as it provides additional insured coverage, without limitation, for completed operations; (ii) automobile liability arising out of vehicles owned, leased, hired, or borrowed by or on behalf of the Contractor; (iii) any insurance written on a claims made basis, shall have a retroactive date that coincides with, or precede,

GENERAL CONDITIONS

the commencement of any work under this contract. Evidence of such coverage shall be maintained for a minimum of six (6) years beyond the expiration of the project. Contractor shall grant to Owner a waiver of any right to subrogation which any insurer of said Contractor may acquire against the Owner by virtue of the payment of any loss under such insurance. Contractor shall agree to obtain any endorsement that may be necessary to affect this waiver of subrogation, but this provision applies regardless of whether or not the Owner has received a waiver of subrogation endorsement from the insurer.

2. King County will not accept Certificates of Insurance Alone. Improperly Completed Endorsements will be returned to your insured for correction by an authorized representative of the insurance company.
3. For any claims related to this project, the Contractor's insurance coverage, except Workers' Compensation insurance, shall be primary insurance as respects the Owner, its officers, officials, agents, partners, employees, and volunteers. Any insurance or self-insurance maintained or expired by the Owner, its officers, officials, agents, partners, employees, volunteers, or shall be excess of the Contractor's insurance and shall not contribute with it. King County Housing Authority's Insurance is Non-Contributory in Claims Settlement Funding.
4. The "General description of agreement(s) and/or activity(s) insured" shall include reference to the activity and/or to either specific King County Housing Authority's; project of site name, contract number, lease number, permit number or construction approval number.
5. Each insurance policy required by this clause shall be endorsed to state that coverage shall not be canceled or materially changed, except after thirty (30) days' [ten (10) days for non-payment of premium] prior written notice by certified mail, return receipt requested, has been given to the Owner.
6. Maintenance of the proper insurance for the duration of the contract is a material element of the contract. Material changes in the required coverage or cancellation of the coverage shall constitute a material breach of the contract.
7. Builders Risk / Course of Construction policies shall contain the following provisions:
 - a. The King County Housing Authority shall be named as loss payee.
 - b. The insurer shall waive all rights of subrogation against the Owner and the Property Manager, its officers, officials, employees and volunteers.

2.6 ACCEPTABILITY OF INSURERS

- A. Insurance is to be placed with insurers with a current A.M. Best's rating of no less than A-VII. The name of the Insurance Company underwriting the coverage and its address shall be noted on the endorsement form. Contractors must provide written verification of their insurer's rating.

2.7 VERIFICATION OF COVERAGE

- A. Contractor shall furnish the Owner with original certificates and amendatory endorsements effecting coverage required by this clause. All certificates and endorsements are to be received and approved by the Owner before work commences in sufficient time to permit contractor to remedy any deficiencies. The Owner reserves the right to require complete, certified copies of all required insurance policies or pertinent parts thereof, including endorsements affecting the coverage required by these specifications at any time.

2.8 SUBCONTRACTORS

- A. Subcontractors shall include the Contractor as additional insured under their policies. All coverage's for subcontractors shall be subject to all of the requirements stated herein. Contractor shall be responsible for the adequacy of required coverages for subcontractors, and compile related certificates of insurance and endorsements evidencing subcontractors' compliance.

2.9 PAYMENT AND PERFORMANCE BONDS

- A. Payment and performance bonds for 100% of the Contract Award Amount shall be furnished for the Work, using the Payment Bond and Performance Bond form AIA – form A312. Change order increases of cumulative 15% increments require revisions to the bond to match the new Contract Sum.

GENERAL CONDITIONS

PART 3 - PERFORMANCE

3.1 CONTRACTOR CONTROL AND SUPERVISION

- A. 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, and shall be responsible to Owner for acts and omissions of Contractor, Subcontractors, and their employees and agents.
- B. Contractor shall enforce strict discipline and good order among Contractor's employees and other persons performing the Work. Contractor shall not permit employment of persons not skilled in tasks assigned to them. Owner may, by Notice, request Contractor to remove from the Work or Project site any employee Owner reasonably deems incompetent, careless, or otherwise objectionable.
- C. The Contractor shall perform on the site, and with its own organization, work equivalent to at least 12% of the total amount of work to be performed under the contract.
- D. Work Hours: The Contractor's allowable hours of operation shall be limited to those hours respective to the relevant ordinance in the controlling jurisdiction (i.e. King County).

3.2 PERMITS, FEES, AND NOTICES

- A. Unless otherwise provided in the Contract Documents, Contractor shall pay for and obtain all permits, licenses, and coordinate inspections necessary for proper execution and completion of the Work. Prior to final payment, the approved, signed permits shall be delivered to Owner.

3.3 PREVAILING WAGES

- A. Statutes of the State of Washington RCW 39.12 as amended shall apply to this contract. Requirements, in brief, are stated below:
 - 1. There shall be paid each laborer or mechanic of the Contractor or sub-Contractor engaged in work on the project under this contract in the trade or occupation listed in the schedule of Wage Rates, as determined by the Department of Labor and Industries, not less than the hourly wage rate listed therein, regardless of any contractual relationship which may be alleged to exist between the Contractor and any sub-contractor and such laborers and mechanics.
 - 2. The "prevailing rate or wage" contained in the wage determination include health and welfare fund contributions and other fringe benefits collectively bargained for by the various management and labor organizations. Prevailing wages shall be paid based on the most recent semi-annual list as required by the Department of Labor and Industries (L&I).
 - 3. In case any dispute arises as to what are the prevailing rates for wages of work of a similar nature, and such disputes cannot be resolved by the parties involved, including labor and management representatives, the matter shall be referred for arbitration to the Director of the Department of Labor and Industries of the State of Washington, and the Director's decision shall be final and conclusive and binding on all parties involved in the dispute.
- B. Before commencing the Work, Contractor shall file a statement of "Intent to Pay Prevailing Wages."
- C. After completion of the Work, Contractor shall file an "Affidavit of Wages Paid."

3.4 EQUAL EMPLOYMENT OPPORTUNITY

- A. During performance of the Work:

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1. Contractor shall not discriminate against any employee or applicant for employment because of race, creed, color, national origin, sex, age, marital status, the presence of any physical, sensory, or mental disability, sexual orientation, Vietnam-era veteran status, disabled veteran status or political affiliation, nor commit any unfair practices as defined in RCW 49.60.
2. The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, national origin, of any physical, sensory, or mental disability, sexual orientation, Vietnam-era veteran status, disabled veteran status, or political affiliation.
3. The Contractor shall give all notices and comply with all applicable laws, ordinances, rules, regulations and orders in regard to Equal Employment Opportunity including but not limited to Executive Order 11246, as amended, Section 503 of the Rehabilitation Act of 1973, as amended, and the rules, regulations, and orders of the Secretary of Labor. The Contractor shall include the terms of this Clause in every subcontract so that such term shall be binding on each Subcontractor.
4. Non-Discrimination R.C.W. 49.60: These special requirements establish minimum requirements for affirmative action and are intended to define and implement the basic discrimination provisions of these specifications. Failure to comply with these requirements may constitute grounds for application of contract default.

3.5 SAFETY PRECAUTIONS

- A. In performing this contract, the Contractor shall provide for protecting the lives and health of employees and other persons; preventing damage to property, materials, supplies, and equipment; and avoid work interruptions. For these purposes, the Contractor shall:
 1. Follow Washington Industrial Safety and Health Act (WISHA) regional directives and provide a site-specific safety program that will require an accident prevention and hazard analysis plan for the contractor and each subcontractor on the work site. The Contractor shall submit a site-specific safety plan to the Owner's representative prior to the initial scheduled construction meeting.
 2. Provide adequate safety devices and measures including, but not limited to, the appropriate safety literature, notice, training, permits, placement and use of barricades, signs, signal lights, ladders, scaffolding, staging, runways, hoist, construction elevators, shoring, temporary lighting, grounded outlets, wiring, hazardous materials, vehicles, construction processes, and equipment required by Chapter 19.27 RCW, State Building Code (Uniform Building, Electrical, Mechanical, Fire, and Plumbing Codes); Chapter 212-12 WAC, Fire Marshal Standards, Chapter 49.17 RCW, WISHA; Chapter 296-155 WAC, Safety Standards for Construction Work; Chapter 296-65 WAC; WISHA Asbestos Standard; WAC 296-62-071, Respirator Standard; WAC 296-62, General Occupation Health Standards, WAC 296-24, General Safety and Health Standards, WAC 296-24, General Safety and Health Standards, Chapter 49.70 RCW, and Right to Know Act.
 3. Comply with the State Environmental Policy Act (SEPA), Clean Air Act, Shoreline Management Act, and other applicable federal, state, and local statutes and regulations dealing with the prevention of environmental pollution and the preservation of public natural resources.
 4. Post all permits, notices, and/or approvals in a conspicuous location at the construction site.
 5. Provide any additional measures that the Owner determines to be reasonable and necessary for ensuring a safe environment in areas open to the public. Nothing in this part shall be construed as imposing a duty upon the Owner to prescribe safety conditions relating to employees, public, or agents of the Contractors.
- B. Contractor to maintain safety records: Contractor shall maintain an accurate record of exposure data on all incidents relating to the Work resulting in death, traumatic injury, occupational disease, or damage to property, materials, supplies, or equipment. Contractor shall immediately report any such incident to Owner. Owner shall, at all times, have a right of access to all records of exposure.

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- C. Contractor to provide HazMat training: Contractor shall provide all persons working on the Project site with information and training on hazardous chemicals in their work at the time of their initial assignment, and whenever a new hazard is introduced into their work area.
1. Information. At a minimum, Contractor shall inform persons working on the Project site of:
 - a. WAC: The requirements of chapter 296-62 WAC, General Occupational Health Standards;
 - b. Presence of hazardous chemicals: Any operations in their work area where hazardous chemicals are present; and
 - c. Hazard communications program: The location and availability of written hazard communication programs, including the required list(s) of hazardous chemicals and material safety data sheets required by chapter 296-62 WAC.
 2. Training. At a minimum, Contractor shall provide training for persons working on the Project site which includes:
 - a. Detecting hazardous chemicals: Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);
 - b. Hazards of chemicals: The physical and health hazards of the chemicals in the work area;
 - c. Protection from hazards: The measures such persons can take to protect themselves from these hazards, including specific procedures Contractor, or its Subcontractors, or others have implemented to protect those on the Project site from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used; and
 - d. Hazard communications program: The details of the hazard communications program developed by Contractor, or its Subcontractors, including an explanation of the labeling system and the material safety data sheet, and how employees can obtain and use the appropriate hazard information.
- D. Hazardous, toxic or harmful substances: Contractor's responsibility for hazardous, toxic, or harmful substances shall include the following duties:
1. Illegal use of dangerous substances: Contractor shall not keep, use, dispose, transport, generate, or sell on or about the Project site, any substances now or hereafter designated as, or which are subject to regulation as, hazardous, toxic, dangerous, or harmful by any federal, state or local law, regulation, statute or ordinance (hereinafter collectively referred to as "hazardous substances"), in violation of any such law, regulation, statute, or ordinance, but in no case shall any such hazardous substance be stored on the Project site.
 2. Contractor notifications of spills, failures, inspections, and fines: Contractor shall promptly notify Owner of all spills or releases of any hazardous substances which are otherwise required to be reported to any regulatory agency and pay the cost of cleanup. Contractor shall promptly notify Owner of all failures to comply with any federal, state, or local law, regulation, or ordinance; all inspections of the Project site by any regulatory entity concerning the same; all regulatory orders or fines; and all responses or interim cleanup actions taken by or proposed to be taken by any government entity or private party on the Project site.
- E. Public safety and traffic: All Work shall be performed with due regard for the safety of the public. Contractor shall perform the Work so as to cause a minimum of interruption of vehicular traffic or inconvenience to pedestrians. All arrangements to care for such traffic shall be Contractor's responsibilities. All expenses involved in the maintenance of traffic by way of detours shall be borne by Contractor.

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- F. Contractor to act in an emergency: In an emergency affecting the safety of life or the Work or of adjoining property, Contractor is permitted to act, at its discretion, to prevent such threatened loss or injury, and Contractor shall so act if so authorized or instructed.
- G. No duty of safety by Owner: Nothing provided in this section shall be construed as imposing any duty upon Owner with regard to, or as constituting any express or implied assumption of control or responsibility over, Project site safety, or over any other safety conditions relating to employees or agents of Contractor or any of its Subcontractors, or the public.

3.6 INDEPENDENT CONTRACTOR

- A. The Contractor and Owner agree the Contractor is an independent contractor with respect to the services provided pursuant to this Contract. Nothing in this Contract shall be considered to create a relationship of employer and employee between the parties hereto. Neither the Contractor nor any employee of the Contractor shall be entitled to any benefits accorded Owner employees by virtue of the services provided under this Contract. The Owner shall not be responsible for withholding or otherwise deducting federal income tax or social security or contributing to the State Industrial Insurance Program, or otherwise assuming the duties of an employer with respect to the Contractor, or any employees of the Contractor.

3.7 OPERATIONS, MATERIAL HANDLING, AND STORAGE AREAS

- A. Contractor shall confine all operations, including storage of materials, to Owner-approved areas.
- B. Contractor shall be responsible for the proper care and protection of its materials and equipment delivered to the Project site.
- C. Contractor shall protect and be responsible for any damage or loss to the Work, or to the materials or equipment until the date of Final Acceptance, and shall repair or replace without cost to Owner any damage or loss that may occur.

3.8 PRIOR NOTICE OF EXCAVATION

- A. Prior to any excavation Contractor shall engage a locate service for all underground facilities or utilities. Contractor shall pay all fees for locator services and pay for all damages caused by excavation.

3.9 UNFORESEEN PHYSICAL CONDITIONS

- A. Notice requirement for concealed or unknown conditions: If Contractor encounters conditions at the site which are subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents, or unknown physical conditions of an unusual nature which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then Contractor shall give written notice to Owner promptly and in no event later than seven Days after the first observance of the conditions. Conditions shall not be disturbed prior to such notice.
- B. Adjustment in Contract Time and Contract Sum: If such conditions differ materially and cause a change in Contractor's cost of, or time required for, performance of any part of the Work, the Contractor may be entitled to an equitable adjustment in the Contract Time or Contract Sum, or both, provided it makes a request therefore as provided in Part 5.

3.10 PROTECTION OF EXISTING STRUCTURES, EQUIPMENT, VEGETATION, UTILITIES, AND IMPROVEMENTS

- A. Contractor shall protect from damage all existing conditions, including soils, structures, equipment, improvements, utilities, and vegetation at or near the Project site; and on adjacent property of a third party, the locations of which are made known to or should be known by Contractor. Contractor shall repair any damage,

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including that to the property of a third party, resulting from failure to comply with the requirements of the Contract Documents, any defects of equipment, material, workmanship or design furnished by the Contractor, or failure by Contractor or subcontractor at any tier to exercise reasonable care in performing the Work. If Contractor fails or refuses to repair the damage promptly, Owner may have the necessary work performed and charge the cost to Contractor.

- B. New work which connects to existing work shall correspond in all respects with that to which it connects and/or be similar to existing work unless otherwise required by the Specifications.

3.11 MATERIAL AND EQUIPMENT

- A. All equipment, material, and articles incorporated into the Work shall be new and of the most suitable grade for the purpose intended, unless otherwise specifically provided in the Contract Documents. References in the Specifications to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard quality and shall not be construed as limiting competition. Contractor may, at its option, use any equipment, material, article, or process that, in the judgment of Owner, is equal to that named in the Specifications, unless otherwise specifically provided in the Contract Documents.
- B. Substitutions shall be considered where qualities and attributes including, but not limited to, cost, performance, weight, size, durability, visual effect, and specific features and requirements indicated are deemed equal or better by the Owner at the Owner's sole discretion. All requests for substitutions shall be made in writing to Owner and shall not be deemed to be approved unless approved in writing by Owner.

3.12 CORRECTION OF NONCONFORMING WORK

- A. Contractor shall promptly correct Work found by Owner not to conform to the requirements of the Contract Documents, whether observed before or after Final Acceptance.
- B. If Contractor fails to correct nonconforming Work, Owner may replace, correct, or remove the nonconforming Work and charge the cost thereof to the Contractor.

3.13 CLEAN UP

- A. Contractor shall at all times keep the Project site, including hauling routes, infrastructures, utilities, and storage areas, free from accumulations of waste materials. Before completing the Work, Contractor shall remove from the premises its rubbish, tools, scaffolding, equipment, and materials. Upon completing the Work, Contractor shall leave the Project site in a clean, neat, and orderly condition satisfactory to Owner. If Contractor fails to clean up as provided herein, and after reasonable notice from Owner, Owner may do so and the cost thereof shall be charged to Contractor.

3.14 SUBCONTRACTORS AND SUPPLIERS

- A. Contractor shall utilize Subcontractors and suppliers which are experienced and qualified.
- B. By appropriate written agreement, Contractor shall require each Subcontractor to be bound to Contractor by terms of those Contract Documents, and to assume toward Contractor all the obligations and responsibilities which Contractor assumes toward Owner in accordance with the Contract Documents. Each Subcontract shall preserve and protect the rights of Owner in accordance with the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights. Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. However, nothing in this paragraph shall be construed to alter the contractual relations between Contractor and its Subcontractors with respect to insurance or bonds.
- C. Contractor shall schedule, supervise, and coordinate the operations of all Subcontractors. No Subcontracting of any of the Work shall relieve Contractor from its responsibility for the performance of the Work in accordance with the Contract Documents or any other obligations of the Contract Documents.

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- D. It is the Contractor's responsibility to pay its Subcontractors and material suppliers on a timely basis. The Owner reserves the right to withhold a portion of the Contractor's payment if the Contractor fails to make timely payments to the Subcontractors and material suppliers.
- E. The Contract Documents shall not be construed to create a contractual relationship of any kind between the Owner and any Subcontractor; or any persons other than Owner and Contractor.
- F. The Contractor shall not enter into any subcontract with any subcontractor who has been suspended or debarred from participating in contracting programs by any agency of the United States Government or by any state, territory, or municipality.

3.15 INDEMNIFICATION

- A. The Contractor hereby agrees to indemnify, defend, and hold harmless the Authority, its successors and assigns, director, officers, officials, employees, agents, partners and volunteers (all foregoing singly and collectively (Indemnities")) from a and against any and all claims, losses, harm costs, liabilities, damages and expenses, including, but not limited to, reasonable attorney's fees arising or resulting from the performance of the services, or the acts or omissions of the Contractor its successors, and assigns, employees, subcontractors or anyone acting on the contractor's behalf in connection with this Contract or its performance of this Contract.
- B. Provided, however, that the Contractor will not be required to indemnify, defend, or save harmless the indemnitee as provided in the preceding paragraphs of this section if the claim, suit, or action for injuries, death, or damages is caused by the sole negligence of the indemnitee. Where such claims, suites, or actions result from the concurrent negligence of (a) the indemnitee or the indemnitee's agents or employees and (b) the Contractor or the Contractor's agent or employee, the indemnity provisions provided in the proceeding paragraphs of this section shall be valid and enforceable only to the extent of the Contractor's negligence or the negligence of its agents and employees..
- C. The foregoing indemnity is specifically and expressly intended to constitute a waiver of the Contractor's immunity under Washington's Industrial Insurance act, RCW Title 51. The parties acknowledge that these provisions were specifically negotiated and agreed upon by them. If any portion of this indemnity clause is invalid or unenforceable, it shall be deemed excised and the remaining portions of the clause shall be given full force and effect.
- D. The Contractor hereby agrees to require all its Subcontractors or anyone acting under its direction or control or on its behalf in connection with or incidental to the performance of this Contract to execute an indemnity clause identical to the preceding clause, specifically naming the Owner as indemnity, and failure to do so shall constitute a material breach of this Contract by the Contractor.

3.16 PROHIBITION AGAINST LIENS

- A. The Contractor is prohibited from placing a lien on the Owner's property. This prohibition shall apply to all subcontractors of any tier and all materials suppliers, in accordance with RCW 35.82.190.

3.17 DAMAGES FOR FAILURE TO ACHIEVE TIMELY COMPLETION

- A. Liquidated Damages
 - 1. Timely performance and completion of the Work is essential to Owner and time limits stated in the Contract Documents are of the essence. The liquidated damage amounts set forth will be assessed not as a penalty, but as liquidated damages for breach of the Contract Documents. This amount is fixed and agreed upon by and between the Contractor and Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would in such event sustain. This amount shall be construed as the actual amount of damages sustained by the Owner, and may be retained by the Owner and deducted from any payments to the Contractor.

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2. If different completion dates are specified in the contract for separate parts or stages of the work, the amount of liquidated damages shall be assessed on those parts or stages which are delayed.

3.18 WAIVER AND SEVERABILITY

- A. The failure or delay of either party to insist on performance of any provision of the Contract, or to exercise any right or remedy available under the Contract, shall not be construed as a waiver of that provision, right, or remedy in any later instance. Waiver or breach of any provision of the Contract shall not be construed to be a waiver of any other or subsequent breach and shall not be construed to be a modification of the terms of the Contract, unless the Contract is modified pursuant to the Clause entitled "Contract Modifications" herein.
- B. If any provision of the Contract is or becomes void or unenforceable by operation of law, the remaining provisions shall be valid and enforceable.

PART 4 - PAYMENTS AND COMPLETION

4.1 CONTRACT SUM

- A. The Contract Sum shall include all taxes imposed by law and properly chargeable to the Project, including sales tax. The Contractor shall pay the WSST to the Department of Revenue and shall furnish proof of payment to the Owner if requested.
- B. The retail sales tax does not apply to the gross contract price.
- C. Prime and subcontractors are required to pay retail sales tax upon all purchases of materials, including prefabricated and precast items, equipment, leases or rentals of tools, consumables, and other tangible personal property which is installed, applied, attached, or otherwise incorporated in their work.

4.2 APPLICATION FOR PAYMENT

- A. At monthly intervals, unless determined otherwise by Owner, Contractor shall submit to Owner an Application for Payment for Work completed in accordance with the Contract Documents. Each application shall be supported by such substantiating data as Owner may require.
- B. Each invoice shall include the following statement: "I hereby certify that the items listed are proper charges for materials, merchandise or services provided to the King County Housing Authority, and that all goods and/or services have been provided; that prevailing wages have been paid in accordance with the approved statements of intent filed with the Department of Labor and Industries; and that sub-contractors and/or suppliers have been paid, less earned retainage, as their interest appears in the last payment received."
- C. Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule. The Contractor shall submit a Schedule of Values to the Owner and Architect within thirty (30) days of contract execution and at least fourteen (14) days before the first Application for Payment. 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, unless objected to by the Owner, shall be used as a basis for reviewing the Contractor's Applications for Payment. Each Application for Payment shall be consistent with previous applications and payments.
- D. Owner shall retain 5% of the amount of each progress payment until 45 Days after Final Acceptance and receipt of all documents required by law or the Contract Documents, including releases by Washington State Employment Security Department and Washington State Department of Revenue, Department of Labor & Industries, and consent of surety to release of the retainage.
- E. Waivers of Lien: With each Application for Payment, submit conditional waivers lien from every entity who is lawfully entitled to file a lien arising out of the Contract and related to the Work covered by the payment.
 1. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.

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2. When an application shows completion of an item, submit final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - a. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

F. Final Payment Application: Submit final Application for Payment with releases and close out supporting documentation.

G. Approved payments shall be mailed to the Contractor within 30 days.

4.3 FINAL COMPLETION, ACCEPTANCE, AND PAYMENT

- A. The Owner shall make a final inspection of the Work on receipt of (1) written notice from the Contractor that the Work is ready for final inspection and (2) a final Application for Payment. When the Owner finds the Work acceptable and fully performed under the Contract Documents, and the Contractor has delivered to the Owner all warranties, permits, and operations manuals, the Owner will issue a Notice of Final Completion.
- B. Acceptance of final payment by Contractor, or any Subcontractor, shall constitute a waiver and release to Owner of all claims by Contractor, or any such Subcontractor, for an increase in the Contract Sum or the Contract Time, and for every act or omission of Owner relating to or arising out of the Work, except for those Claims made in accordance with the procedures, including the time limits, set forth in PART 7 - .

PART 5 - CHANGES

5.1 CHANGE IN THE WORK

- A. Owner may, at any time and without notice to Contractor's surety, order additions, deletions, revisions, or other changes in the Work. These changes in the Work shall be incorporated into the Contract Documents through the execution of Change Orders. If any change in the Work ordered by Owner causes an increase or decrease in the Contract Sum or the Contract Time, an equitable adjustment shall be made as provided in 5.2 and 5.3.
- B. Pending agreement on the terms of the Change Order, Owner may direct Contractor to proceed immediately with the Change Order Work. Contractor shall not proceed with any change in the Work until it has obtained Owner's approval.
- C. The Contractor agrees that any change in the Contract Amount or Contract Time provided in a Change Order is full and complete compensation to the Contractor for the change(s) to the work, deleted work, modified work, direct or indirect impact on the Contractor's schedule, and for any equitable adjustment or time extension to which the Contractor may be entitled to in this Change Order, pursuant to the Contract between the Owner and Contractor.

5.2 CHANGE IN THE CONTRACT SUM

- A. Change Order Pricing - Fixed Price: When the fixed price or time and materials method is used to determine the value of any Work covered by a Change Order, or of a request for an equitable adjustment in the Contract Sum, the following procedures shall apply:
 1. Contractor's Change Order proposal, or request for adjustment in the Contract Sum, shall be accompanied by a complete itemization of the costs, including labor, material, subcontractor costs, and overhead and profit. The costs shall be itemized in the manner set forth below, and shall be submitted on breakdown sheets with documentation in a form approved by Owner.
 2. Any request for adjustment of Contract Sum shall include only the following items:

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- a. Craft labor costs for Contractors and Subcontractors.
 - 1) Basic wages and benefits: Hourly rates and benefits according to applicable prevailing wages.
 - 2) Direct supervision shall not to exceed 15% of the cost of direct labor. No supervision markup shall be allowed for a working supervisor's hours.
 - 3) Worker's Insurance. Direct contributions to the State for industrial insurance, medical aid, and supplemental pension by the class and rates established by L&I.
 - 4) Federal Insurance. Direct contributions required by the Federal Insurance Compensation Act; Federal Unemployment Tax Act; and the State Unemployment Compensation Act.
 - 5) Safety and small tools: 4% of the sum of the amounts calculated in (1), (2), and (3) above.
- b. Material Costs: Material costs and applicable sales tax shall be developed from actual known costs, supplier quotations or standard industry pricing guides and shall consider all available discounts. Freight costs, express charges, or special delivery charges shall be itemized.
- c. Equipment Costs: Itemization of the type of equipment and the estimated or actual length of time the equipment appropriate for the Work is or will be used on the change in the Work. Costs will be allowed for equipment and applicable sales tax only if used solely for the changed Work, or for additional rental costs actually incurred by the Contractor. The Date Quest Rental Rate (Blue Book) shall be used as a basis for establishing rental rates of equipment not listed in the above sources. The maximum rate for standby equipment shall not exceed 50% of the applicable rate.
- d. Allowance for Overhead: This allowance shall compensate Contractor for all noncraft labor, temporary construction facilities, field engineering, schedule updating, as-built drawings, home office cost, B&O taxes, office engineering, estimating costs, additional overhead because of extended time and any other cost incidental to the change in the Work. This allowance shall be strictly limited in all cases an amount not to exceed the following:
 - 1) For Contractor, for any Work actually performed by Contractor's own forces, 16% of the cost.
 - 2) For each Subcontractor (including lower tier subcontractors), for any Work actually performed by its own forces, 16% of the cost.
 - 3) For Contractor, for any Work performed by its Subcontractor(s), 6% of the amount due each Subcontractor.
 - 4) For each Subcontractor, for any Work performed by its Subcontractor(s) of any lower tier, 5% of the amount due the sub-Subcontractor.
- e. Allowance for Profit:
 - 1) For Contractor or Subcontractor of any tier for work performed by their forces, 5% of the cost developed in accordance with subsections a, b & c above.
 - 2) For Contractor or Subcontractor of any tier for work performed by a subcontractor of a lower tier, 5% of the Subcontractor cost.
- f. Insurance or Bond Premium: The costs of any change or additional premium of Contractor's liability insurance and public works bond arising directly from the changed Work. The costs of any change in insurance or bond premium shall be added after overhead and profit are calculated.

B. Change Order Pricing - Unit Prices

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1. Work on a unit-price basis as stated in the Specifications and at the price submitted in the Bid Form or as subsequently modified.
 - a. Unit prices shall include reimbursement for all direct and indirect costs of the Work, including overhead and profit, and bond and insurance costs; and
 - b. Quantities must be supported by field measurement verified by Owner.

5.3 CHANGE IN THE CONTRACT TIME

- A. The Contract Time shall only be changed by a Change Order. Contractor shall immediately notify Owner, and shall include any request for a change in the Contract Time in its Change Order proposal.
- B. If the time of Contractor's performance is changed due to an act of Force Majeure, Contractor shall request for an equitable adjustment in the Contract Time in writing within 24-hours of the occurrence.

PART 6 - CLAIMS AND DISPUTE RESOLUTION

6.1 CLAIMS PROCEDURE

- A. If the parties fail to reach agreement regarding any dispute arising from the Contract Documents, Contractor's only remedy shall be to file a Claim with Owner within 30 Days from Owner's final offer.
- B. The Claim shall be deemed to cover all changes in cost and time (including direct, indirect, impact, and consequential) to which Contractor may be entitled. It shall be fully substantiated and documented.
- C. After Contractor has submitted a fully-documented Claim, Owner shall respond, in writing, to Contractor with a decision within 30 Days from the date the Claim is received.
- D. Contractor shall proceed with performance of the Work pending final resolution of any Claim. Owner's written decision as set forth above shall be final and conclusive as to all matters set forth in the Claim.
- E. Any Claim of the Contractor against the Owner for damages, additional compensation, or additional time, shall be conclusively deemed to have been waived by the Contractor unless timely made in accordance with the requirements of this section.

6.2 ARBITRATION

- A. If Contractor disagrees with Owner's decision rendered in accordance with paragraph 6.1C, Contractor shall provide Owner with a written demand for arbitration. No demand for arbitration of any such Claim shall be made later than 30 Days after the date of Owner's decision on such Claim; failure to demand arbitration within said 30 Day period shall result in Owner's decision being final and binding upon Contractor and its Subcontractors.
 1. Notice of the demand for arbitration shall be filed with the American Arbitration Association (AAA), with a copy provided to Owner. The parties shall negotiate or mediate under the Voluntary Construction Mediation Rules of the AAA, or mutually acceptable service.
- B. All Claims arising out of the Work shall be resolved by arbitration. The judgment upon the arbitration award may be entered, or review of the award may occur, in the superior court having jurisdiction thereof. No independent legal action relating to or arising from the Work shall be maintained.

6.3 CLAIMS AUDITS

- A. All Claims filed against Owner shall be subject to audit at any time following the filing of the Claim. Failure of Contractor, or Subcontractors of any tier, to maintain and retain sufficient records to allow Owner to verify all

GENERAL CONDITIONS

or a portion of the Claim or to permit Owner access to the books and records of Contractor, or Subcontractors of any tier, shall constitute a waiver of the Claim and shall bar any recovery.

1. In support of Owner audit of any Claim, Contractor shall promptly make available to Owner all records relating to the Work.

PART 7 - TERMINATION OF THE WORK

7.1 TERMINATION BY OWNER FOR CAUSE

- A. Owner may, upon a written Notice to Contractor and to its surety, terminate (without prejudice to any right or remedy of Owner) the Work, or any part of it, for cause upon the occurrence of any one or more of the following events:
 1. Contractor fails to prosecute the Work or any portion thereof with sufficient diligence to ensure Completion of the Work within the Contract Time;
 2. Contractor is adjudged bankrupt, makes a general assignment for the benefit of its creditors, or a receiver is appointed on account of its insolvency;
 3. Contractor fails in a material way to replace or correct Work not in conformance with the Contract Documents;
 4. Contractor repeatedly fails to supply skilled workers or proper materials or equipment;
 5. Contractor repeatedly fails to make prompt payment due to Subcontractors, suppliers, or for labor;
 6. Contractor materially disregards or fails to comply with laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction; or
 7. Contractor is otherwise in material breach of any provision of the Contract Documents.
- B. Upon termination, Owner may at its option:
 1. Take possession of the Project site and take possession of or use all materials, equipment, tools, and construction equipment and machinery thereon owned by Contractor to maintain the orderly progress of, and to finish, the Work;
 2. Finish the Work by whatever other reasonable method it deems expedient.
- C. Owner's rights and duties upon termination are subject to the prior rights and duties of the surety, if any, obligated under any bond provided in accordance with the Contract Documents.
- D. When Owner terminates the Work in accordance with this section, Contractor shall take the actions set forth in paragraph 7.2B, and shall not be entitled to receive further payment until the Work is accepted.
- E. If the unpaid balance of the Contract Sum exceeds the cost of finishing the Work, including compensation for A/E services and expenses made necessary thereby and any other extra costs or damages incurred by Owner in completing the Work, or as a result of Contractor's actions, such excess shall be paid to Contractor. If such costs exceed the unpaid balance, Contractor shall pay the difference to Owner. Contractor shall also be liable for liquidated damages until such reasonable time as may be required for Completion. These obligations for payment shall survive termination.
- F. Termination of the Work in accordance with this section shall not relieve Contractor or its surety of any responsibilities for Work performed.
- G. If Owner terminates Contractor for cause, and it is later determined that none of the circumstances set forth in 7.1A exist, then such termination shall be deemed a termination for convenience pursuant to 7.2.

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7.2 TERMINATION BY OWNER FOR CONVENIENCE

- A. Owner may, upon Notice, terminate (without prejudice to any right or remedy of Owner) the Work, or any part of it, for the convenience of Owner.
- B. Unless Owner directs otherwise, after receipt of a Notice of termination for either cause or convenience, Contractor shall promptly:
 - 1. Stop performing Work on the date and as specified in the notice of termination;
 - 2. Place no further orders or subcontracts for materials, equipment, services or facilities, except as may be necessary for completion of such portion of the Work as is not terminated;
 - 3. Cancel all orders and subcontracts, upon terms acceptable to Owner, to the extent that they relate to the performance of Work terminated;

PART 8 - REQUESTS FOR INFORMATION (RFIs)

8.1 RESPONSIBILITIES

- A. As stated in the Bid Documents, it is the responsibility of each Bidder to carefully study and compare the Bid Documents, examine the project site, and promptly advise the Owner of any discrepancies in, or questions about, the Bid Documents or field conditions, prior to submitting their Bid.
- B. If, in spite of this, questions remain during the bidding process, the Contractor may request clarification in accordance with the Instructions to Bidders and as identified during the pre-bid meeting.
- C. If, in spite of the responsibility outlined in paragraph A, above, questions remain after award of the project, the contractor may request clarification in accordance with the RFI process outlined below.
- D. Note that proposals for product Substitutions (allowable only if the product is no longer available from any of the listed manufacturers), are to be made through the RFI process but must also have a completed Request for Substitution form.

8.2 CONTENT AND PROCESS

- A. Any RFI, regardless of whether a supplier, subcontractor, or Contractor has a request, must come from the Contractor to the Architect at a minimum fourteen (14) Days before a response is needed.
- B. Contractor shall include a suggestion/proposed resolution/solution as part of RFI.
- C. Contractor shall include a date by when a response is needed. RFIs will be responded to as received, except that those requiring priority action will be acted on first. The Owner will respond to the RFI within a reasonable time frame. However, in no case shall the RFI process be a reason for a claim of delay, or request for extension of time, from the Contractor.
- D. A response consisting of an interpretation or supplemental instruction that does not require a change to the Contract cost or time will be entered on the RFI form itself, and returned to the Contractor.
- E. If an RFI leads to a potential change to cost or time, the Owner may, at the request of the Contractor, consider a change request, as described in General Conditions part 9 - Contract Modification Procedures.

PART 9 - CONTRACT MODIFICATION PROCEDURES

9.1 TYPES OF CHANGE AUTHORIZATIONS

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- A. Changes to the Work detailed in the Contract Documents can be authorized in any one of two ways:
 - 1. **Minor Changes:** The Owner may authorize minor changes in the Work as needed when such changes do not involve extension of the Contract Time. This work is documented as a Minor Change at no additional cost, and paid under that item in the Schedule of Values, but does not become part of a Change Order.
 - 2. **Field Directive:** A Field Directive can originate from the Owner as a Field Directive or Contractor's request in the form of a Request for Interpretation. The Owner requests a cost Proposal from the Contractor, unless the Contractor has submitted that complete information along with its original request. Once the Contractor's Proposal has been negotiated and agreed on, and signed by the Owner, the Contractor is issued a Field Directive and is authorized to proceed with the Work as specified.
- B. **Change Orders (CO)** are comprised of previously issued Field Directives. Once executed by the Owner and the Contractor, each Change Order becomes a formal modification to the original Contract. The Contractor may not request payment for, and the Owner will not pay for, any changed work until payment is authorized via an executed Change Order.

9.2 GENERAL REQUIREMENTS

- A. Only an authorized signatory of the Contractor may execute Field Directives and Change Orders.
- B. All processes under this Section shall be documented using Owner-supplied forms.
- C. Contractor has the responsibility to inform the Owner of any condition the Contractor believes to be a "changed condition" or a condition differing from the intent of the Contract Documents in accordance with the Contract and General Conditions.
- D. Should the Contractor, of its own volition, perform modifications or make a change installation without an approved, Change Order, Field Work Directive, or authorized Minor Change, it shall be understood that the Owner is under no obligation to pay for such work.

9.3 REQUEST FOR PROPOSAL AND PROPOSAL PROCESS

- A. All Field Directives must be accompanied by a detailed description of the changed Work, a cost for the work, and address its impact on schedule. This information, together, is called a Change Proposal generated by the Contractor as part of their initial request, or it may be requested by the Owner directly.
- B. If the Contractor finds it necessary to generate a request for a change it should be in the form of a Request for Interpretation (RFI), and the Owner may ask for a Request for Proposal or if the Owner disapproves the request, the reason for disapproval will be stated in the RFI response.
- C. The Contractor is required to respond within (7) seven days of receiving an RFP. The Contractor must notify the Owner within (2) two days of receiving an RFP if additional time is needed to prepare the Change Proposal. The Owner may or may not grant the requested time extension. The Owner may require a response to certain time-sensitive RFPs within less than (7) seven days.
- D. After reviewing the Contractor's Change Proposal, the Owner may request additional information.
- E. Once the information is sufficient for evaluation by the Owner, there may be an exchange of responses with the Contractor until an agreed price has been negotiated. If the parties are unable to agree on a price, the cost will be calculated per General Conditions paragraph 5.2.A.2.
- F. Once the terms of the Contractor's Change Proposal are agreed on, a Field Directive will be processed for signature by all parties.
- G. Once the Field Directive is signed by all parties, Contractor may begin work under that Field Directive, unless already so directed by Owner. The Contractor will be provided an electronic copy of each Field Directive and any attachments. Additional copies are at Contractor's own expense.

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9.4 PROPOSAL CONTENT

A. Regardless of who originates the information, all Change Proposals must have the content described below:

1. A description of the Work:
 - a. Detailed description of changes, material and equipment, and location of change in project.
 - b. Reason for making the changes.
 - c. Supplementary or revised drawing and specifications, and/or references to applicable existing Drawing sheets and Specifications.
 - d. Projected time span for making changes.
 - e. Statement as to whether overtime work is or is not authorized.
2. If a change in the work involves a change to the schedule, the Contractor must provide documentation with each proposal with sufficient data to allow evaluation of the Construction Progress Schedule and Reporting.
3. Cost Information:
 - a. State whether or not there is a cost impact (added cost, or credit) to the change.
 - b. As stated in the Owner's Request for Proposal, the proposed costs should be divided by established bid items, with any new items of work broken out to the same level of detail, and substantiated in one of two ways:
 - 1) **"Order of magnitude" estimate**, with the exact cost to be determined as or after the work is performed, but prior to preparation of the official Change Order. This estimate will have either, or a combination of:
 - a) If the changed work can be accomplished under already established **unit bid prices or component breakdowns in the Schedule of Values**, that is first choice. The unit prices already include the cost of all labor, materials, tools, and equipment, overhead, profit, taxes, etc. necessary to perform the work.
 - b) If there are no established unit bid prices for some or all of the work, provide a **Time & Materials estimate**. Include the cost of all labor, materials, tools, and equipment, overhead, profit, taxes, etc. necessary to perform the work. Submit time sheets or time and material sheets signed by the Owner confirming the number of labor hours expended during the change.
 - 2) **Exact Lump Sum proposal**. The Contractor shall provide an organized, detailed cost estimate, including full breakdown and documentation for all costs, including those of the Contractor, Subcontractors, and lower-tier Subcontractors.
4. All cost estimates must be signed and dated by the Contractor, and must specify the period of time during which the cited prices will be valid.

9.5 DOCUMENTATION OF ORDER OF MAGNITUDE/T&M WORK

A. Provide daily reports of work performed.

9.6 CHANGE ORDER PROCESS

A. As needed, the Owner will prepare one or more Change Orders (CO), which are comprised of previously issued Field Directives. The Owner will prepare Change Orders on the Owner's Change Order form.

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- B. The Change Order will state all prior approved contract amounts, list a summary of all additional authorized Field Directives, and show the totals of the revised contract amounts and contract time adjustments.
- C. The Contractor will receive from the Owner an electronic copy of the Change Order for original signature, to be returned to the Owner within (7) seven calendar days.
- D. The Contractor will be provided with an executed copy.
- E. Once executed by the Owner, and the Contractor, each Change Order becomes a formal modification to the original Contract, and is thereafter part of the Contract Documents.
- F. The Contractor may not request payment for, and the Owner will not pay for, any changed work until payment is authorized via an executed Change Order.

PART 10 - SUBMITTALS

- 10.1 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 10.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.
- 10.2 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect and Owner or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.
- 10.3 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner 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 requirement of the Work and of the Contract Documents.
- 10.4 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been reviewed by the Architect and Owner.
- 10.5 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's and Owner's review of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order and Field Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's and Owner's review thereof.
- 10.6 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's and Owner's review of a resubmission shall not apply to such revisions.
- 10.7 The Owner and/or Architect will review, 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

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with information given and the design concept expressed in the Contract Documents. The Owner's and/or Architect's action will be taken in accordance with the submittal schedule approved by the Owner and/or Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Owner's and/or Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations described in this contract. The Owner's and/or Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Owner's and/or Architect's review of a specific item shall not indicate review of an assembly of which the item is a component.

- 10.8 Submit to Owner and Architect for review a schedule for submittals in tabular format.
- A. Submit at the same time as the preliminary construction progress schedule.
 - B. Coordinate submittal schedule with Contractor's construction schedule and schedule of values.
 - C. Format submittal schedule to allow tracking of submittal status throughout duration of construction.
 - D. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 - E. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.
- 10.9 General Requirements:
- A. Use a single transmittal for related items.
 - B. Submit required product data for the entire specification section as a single submittal. Shop drawings and samples for the same specification section may be separate submittals.
 - C. Use Contractor's form, subject to prior approval by Owner and Architect.
 - D. Identify each submittal with the related Specification Section Number followed by a hyphen and the initials SD (shop drawings); PD (product data); SA (sample); TD (test data); C (calculations); or other applicable initials followed by a hyphen and a sequential number for the submittal.
 - E. Resubmitted submittals shall retain the original submittal number with the addition of a hyphen and R1, R2, etc. to be added to right end of the original number.
 - F. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 - G. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - I. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
 - H. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - I. Provide space for Contractor, Owner, and Architect review stamps.

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- J. When revised for resubmission, identify all changes made since previous submission.
- K. Submittals of product data and/or shop drawings for products other than those listed in the Contract Documents without an approved Substitution Request will not be reviewed, and will be returned "Not Reviewed"
- L. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.

PART 11 - USE OF CONSTRUCTION SITE

11.1 GENERAL USE

- A. Conduct operations to ensure minimum interference with traveled ways and with other contractors working on site.

11.2 CONTRACTOR'S SITE UTILIZATION PLAN

- A. Contractor shall submit a Site Utilization Plan for review and acceptance by the Owner, as a section of the Work Plan. The Site Utilization Plan shall include but not be limited to the following topics.
 1. Laydown area(s)
 2. Cutting areas
 3. Contractor facilities
 4. Parking
 5. Fencing
 6. Staging
 7. Haul routes, taking into account closed roads, roads being used by residents, school traffic at the beginning and ending of day, and children traveling independently in the vicinity.
 8. Material stockpile locations
 9. Establishing an emergency services staging area. Coordinate location with Owner.

11.3 CONSTRUCTION SIGNS

- A. Commercial, Contractor, or advertising signs shall not be allowed on the site, other than way-finding signs unless approved by the Owner.

11.4 COORDINATION WITH OTHER CONTRACTORS

- A. Contractor shall limit its activities to the work and staging areas in its accepted Site Utilization Plan.
- B. Contractor shall coordinate their work and the use of the site with:
 1. Property management's maintenance employees.
 2. Contractors working for an AHJ or utility provider.
 3. Other contractors hired by Owner (e.g. solar contractor)

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11.5 COORDINATION WITH ADJACENT PROPERTY OWNERS

- A. Coordinate with adjacent property owners and tenants/residents to minimize disruption to their activities, and repair impacted property and facilities on the adjacent property Owners'/tenants' land. **NOTE: ALL CONTACT, WRITTEN OR VERBAL, WITH ADJACENT PROPERTY OWNERS AND TENANTS/ RESIDENTS, MUST BE PRE APPROVED BY THE OWNER.**
- B. Provide a monthly written construction outlook to be shared with adjacent property owners and public who is interested in receiving updates to inform about general construction status, timeline, and any significant disruptions such as noise and vibration. All content should be approved by the Owner. Coordinate with the Owner to identify list of recipients and in disseminating the construction newsletter.

11.6 MATERIAL STOCKPILES

- A. Protect all stockpiles accordingly and include plans for stockpile protection in the overall Site Utilization Plan.

11.7 PARKING AND STAGING AREAS

- A. Use only the areas identified in the accepted Site Utilization Plan for staging, material stockpiling, equipment storage, and parking of construction vehicles.
- B. All Contractor's staging, including but not limited to parking, job offices, and material laydown, shall be contained within the property boundary :
- C. On-site parking for non-construction and employee vehicles, as well as for equipment, will be permitted only in areas shown on the accepted Site Utilization Plan. All Contractors' employee cars, other private vehicles, Subcontractors vehicles, and Subcontractors equipment within the site, shall be parked in a legal manner and shall not impede parking and access for users of the site, or for surrounding businesses, homes, or municipalities. Under no circumstances shall the Contractor or its Subcontractors' parking be allowed on roads designated to be closed to Contractor's use
- D. Contactor shall be responsible for obtaining and paying for any off-site staging area. Promptly remove from the site, all equipment and vehicles no longer required to perform the work under this Contract. Failure to remove said equipment and vehicles from the site will result in the Owner arranging for their removal and storage outside the site at the Contractor's expense.

11.8 CONTRACTOR'S SALVAGE AND DEBRIS REMOVAL, AND CLEANUP

- A. Waste material and refuse shall be removed and disposed of properly off site by the Contractor.
- B. Keep the work area clean and orderly. Clean the site and remove all debris daily, or more often if so directed by Owner. The Owner reserves the right to direct Contractor to stop activities and direct clean-up as necessary to maintain site cleanliness. Such action shall not be cause for a claim for delay or extra compensation.
- C. Contractor to keep all hard surfaces in and around the project site free from dirt and debris at all times.
- D. Contractor to provide to the Owner a signed letter of completion post-clearing of hazardous materials, referencing relevant EPA standards and certifying the safety of the work area for re-occupancy.

11.9 CONTRACTOR'S OFFICE

- A. During the performance of this contract maintain a suitable office at the site of work, which shall be the headquarters of the representative authorized to receive drawings, instructions, or other communications or articles. Location of the office to be per the accepted Site Utilization Plan. The Owner may require the Contractor to relocate their office(s) during the course of the Project, at the Contractor's expense.
- B. Communications given to the Contractor's Representative or delivered at the site office in the Contractor's absence shall be deemed to have been delivered to the Contractor.

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- C. Copies of the permits, Drawings, specifications, and all other Contract Documents shall be kept at the site office and available for use at all times.
- D. The Contractor shall provide all pertinent project contact information (names, titles, telephone and facsimile numbers, and email addresses), to the Owner and Architect as soon as the information become available.
- E. The Owner's copier will not be available to the Contractor.

11.10 SANITARY FACILITIES

- A. Provide toilet and wash-up facilities for the work force at approved location(s) at the site. Comply with applicable laws, ordinances, and regulations pertaining to public health and sanitation. Where permitted by governing regulations, provide single-occupant self contained toilet units of either chemical aerated, recirculation type or combustion type; glass fiber reinforced polyester enclosure; equipped with both urinal and stool fixtures. Supply units with tissue and, where not located near separate wash facilities, supply with wet-type hand towels and waste containers. Provide the quantity of units required by codes. Toilet facilities shall be lockable and shall remain locked except while the Contractor is on-site.
- B. Dispose of wastes on a minimum weekly basis, or more frequent if required, preventing unhealthy and/or smelly conditions.

PART 12 - SITE SAFETY AND SECURITY

This section is supplemental to above Section 3.5 Safety Precautions.

12.1 GENERAL RESPONSIBILITIES

- A. This Section outlines general requirements pertaining to security and safety, for Contractors performing work on this Project. It is up to the Contractor to provide and implement a Safety Program to meet the requirements below, and the requirements of all applicable laws and regulation, to result in a safe, accident-free work site.
- B. It is essential that the Contractor implement an effective and vigorous safety and health program to cover and protect all people on the construction site, including workers of Contractor and subcontractors of any tier, suppliers, Owner and their representatives, other contractors on the site, Agencies Having Jurisdiction (AHJ), visitors, and the public. It shall be understood that the full responsibility for providing a safe work place rests with the Contractor.
- C. Contractor shall, at its own cost and expense, protect at least (but not limited to) all entities listed above, from risk of death, injury, or bodily harm arising out of or in any way connected with the Work to be performed. Contractor shall take all necessary precautions for the safety of employees, staff, and other persons on the site of the Work. Contractor shall provide facilities, barricades, other safety and security devices, fencing, signage, demarcation, and services as necessary to effectively protect persons from injury, during the course of construction, and to maximize comfort to all persons using or visiting the site. The process for achieving this shall be shown in the written Safety and Health Program.
- D. The Contractor is also responsible for not impacting the health and safety of the public and residents adjacent to the project site, and/or along any haul or approach routes. The Program shall include measures for the general public and Contractor's worker safety outside their Project Boundary.
- E. The Contractor shall also provide sufficient security and facilities at the site, to protect its own equipment, tools, and materials, and to protect both Contractor's work and existing facilities from unauthorized entry, vandalism, or theft. The Contractor is solely responsible for any and all damage and/or loss to its equipment, materials, and work, and to existing improvements.
- F. Contractor shall at its own expense comply with, enforce, and ensure all entities under its control comply with all safety standards and specific safety requirements of Owner and of all federal, state and local Agencies Having Jurisdiction as now enacted or hereafter enacted or amended.

GENERAL CONDITIONS

- G. The Contractor further agrees to indemnify and hold the Owner, Assignee(s), if any, and Architect(s) harmless for, of and from any loss including but not limited to fines, legal fees, penalties, and corrective measures sustained by reason of the Contractor's failure to comply with said laws, rules, regulations, and standards in connection with its performance under this contract.
- H. The Contractor shall include the provisions of this Section in every subcontract so that such provisions will be binding on each Subcontractor of every tier.

12.2 CONTRACTOR'S SAFETY AND HEALTH PROGRAM

- A. The Contractor's program must meet or exceed Division of Occupational Safety and Health - or DOSH (formerly called WISHA) and other WA Labor & Industries Department requirements.
- B. Submit to Owner for review, Contractor's Safety and Health Program. This written Safety and Health Program shall also include a Site Specific supplement, specific to this Project and its activities, and to this site. The Contractor's Safety and Health Program shall include but not be limited to the following items:
1. Site Specific Health and Safety Plan, per State requirements, including but not limited to:
 - a. Names and 24 hour emergency contact phone numbers for its Corporate Safety Director and its designated Project Site Safety Officer. Contractor shall notify Owner of changes to these personnel and/or their phone numbers.
 2. Accident Prevention Plan, per State requirements, including but not limited to:
 - a. Contractor's role and responsibilities pertaining to safety on the job site, training, and corrective action.
 - b. Specific measures to protect the health and safety of all people on and adjacent to the site, including the public and residents.
 - c. Specific measures to continue and/or provide fire and life/safety protection for everyone on and near the Project site.
 - d. Methods for Contractor's and Subcontractors' of all tiers personnel, and Owner and their representatives, to elevate safety concerns.
 - e. Progressive Disciplinary Plan for Contractor workers and Subcontractors of every tier in case of discovery of safety violations.
 - f. Tracking and recording methods.
 3. Site Security Plan, including but not limited to:
 - a. Barriers and barricades to prevent unauthorized entry to construction areas and to protect existing facilities from damage during construction, and at hazardous locations, complete with signs, warning lights and similar devices where appropriate.
 - b. Storage system for materials and equipment to prevent theft and vandalism.
 4. The Contractor shall involve Subcontractors in implementing a healthy jobsite plan for the Project.
 5. Contractor's program for an alcohol- and narcotic-free jobsite and workers, including posted notices, awareness programs, and procedure for dealing with violations.

C. The Contractor shall designate, in writing, a responsible member of the Contractor's organization to be the Project Site Safety Officer. **The designated Safety Officer shall be:**

 - on site daily, with safety as a key function
 - knowledgeable in safety principles and practice through training and experience

GENERAL CONDITIONS

- empowered to dictate site activities to accomplish safety goals
- Responsible for preparing the Contractor's Project-specific Safety Program, carrying out that Program, and preventing accidents, and shall enable communications among all parties on the overall project site, including work performed by others, to ensure safe operations.

The Owner shall be advised in writing, subject to approval, within fifteen (15) Business Days of an anticipated change of the designated Safety Officer.

- D. In the event that Owner or its representative, regulatory agencies, or jurisdictions determine the Contractor's Safety Program to be inadequate to protect employees and the public, the Contractor shall:
1. Modify the program and execute it to meet the requirements of said regulatory agencies, jurisdictions, and Owner, at no additional expense to Owner.
 2. Provide the Owner with the revisions to the program within seven (7) Calendar Days of the notice of deficiency.

12.3 ADDITIONAL REQUIREMENTS OF CONTRACTOR'S SAFETY PROGRAM

- A. Operations Outside the Construction Area -- Construction activities that occur outside the Contractor's fenced project site, e.g., trucking or equipment movement, shall be accomplished in a manner that imposes a minimum impact on residents and the public. All work occurring either inside or outside of the established work zone must consider public, resident, and Contractor worker safety.

12.4 FENCING

- A. Protect any existing fencing bordering the property. Repair or replace all fencing damaged or lost for any reason during construction, with no additional cost to the Owner.
- B. Provide all barricades, fencing, and walkways required by code or County/City ordinance(s). Secure and pay for all necessary permits.

12.5 EXECUTION AND AUDIT OF CONTRACTOR'S SAFETY PROGRAM

- A. The Contractor shall continually assess and inspect the Work site to assure the safest working conditions and actions. Contractor shall conduct inspections to determine that safe working conditions and equipment exist, and accepts responsibility at all times for providing a safe place to work for its employees and for employees of its subcontractors and suppliers of material and equipment, and a safe environment for the public. Contractor accepts responsibility for adequacy of and required use of all safety equipment and for full compliance with aforesaid laws, orders, citations, rules, regulations, standards, and statutes.
- B. Contractor shall enforce a disciplinary action schedule in the event any safety violations are discovered.
- C. The Owner may perform audits for safety, housekeeping, and environmental conditions. Contractor and Subcontractors shall participate and cooperate in such audits. Notwithstanding such audits, the Contractor shall retain sole responsibility for the safety of the site and all people on it. Ongoing work that is not in compliance with Contractor's Program, or is not in compliance with laws and regulations, or is considered a safety or health risk, shall be corrected immediately.
- D. In certain circumstances, a safety violation may cause an AHJ-or in cases of a situation immediately dangerous to life and/or health, the Owner or their representative-to require the Contractor to cease work on and to vacate the affected portion of the project site, until Contractor corrects such condition. In such case,
- Contractor may not make any claim for delay as a result of this action;
 - Owner may charge Contractor for any fines imposed on Owner by any government officials arising from such violations; and

GENERAL CONDITIONS

- Owner may charge Contractor for the actual costs of delay in the construction schedule arising from violations, and additional damages (including, without limitation, consequential or indirect damages such as per diem interest charges), at Owner's discretion, if the Work is delayed as a result of the violations or unsafe conditions.

- E. Contractor shall immediately notify the Owner when a federal or state safety representative is conducting an inspection or investigation of the construction operations.

12.6 SAFETY EQUIPMENT

- A. Provide all equipment, including safety equipment, necessary for the Work performed.
- B. Ensure that necessary air monitoring, ventilation equipment, protective clothing, and other supplies and equipment as specified are available to implement the Accident Prevention Program.
- C. Company identification shall be readily visible on all hard hats.

12.7 COMMUNICATION, MEETINGS AND REPORTING

- A. Contractor shall maintain communication with subcontractors of every tier, other contractors, and Owner to provide effective implementation of safety requirements.
- B. Accident Reporting Responsibility
 1. The Contractor shall report immediately to the Owner any injury to any person that occurs on or near the site.
 2. Property damage or near-miss accidents shall also be reported. All serious and time loss accidents shall be thoroughly investigated by the Contractor. Contractor's safety program shall show procedures for investigating all such accidents. Copies of such reports shall be submitted to the Owner. The Owner may elect to be involved in these investigations.
 3. Include any police, L&I, or other official documents in reporting.
- C. Weekly Safety Report
 1. Contractor shall prepare a weekly safety report, detailing safety work hours by each Contractor and Subcontractor, recordable injuries, incident rate, lost time accidents, and lost workday case rates. Contractor shall prepare copies of weekly walk around inspection sheets as required by WAC 296-155-110-96. Promptly provide a copy of all such reports to the Owner for the Project Records.
- D. Safety Meetings
 1. Contractor's Safety Officer shall arrange for and conduct a monthly Site Safety Meeting. Owner shall be invited to the meetings, as their safety falls under Contractor's control.
 2. Contractor shall hold weekly tool box safety meetings for all its crews.
 3. Contractor shall promptly furnish a copy of minutes of all safety meetings, and attendance roster, to the Owner for the Project Records.
 4. Contractor is responsible for all orientation and training required; Subcontractors of all tiers shall be included in all training. Contractor shall also provide Safety Orientation to all visitors to the site, including Owner and Owner's Representatives.
 5. Contractor shall document all orientation and training activities, including Attendance Lists, and shall make such documentation available on request.

12.8 IDENTIFICATION OF CONTRACTOR PERSONNEL, SUPPLIERS, AND VISITORS

GENERAL CONDITIONS

- A. Contractor employees must identify themselves when requested by security representatives or Owner or its representatives. Employees should know the Contractor's name and job location for such identification. Visitors to Contractor must follow established safety procedures. Contractor employees and visitors are not permitted on site during hours of non-operation by the Contractor.

PART 13 - TEMPORARY ENVIRONMENTAL CONTROLS

13.1 REFERENCES

- A. King County
 1. Noise/Environmental Ordinances
- B. KCSWM
 1. King County Surface Water Design Manual, K.C. Department of Public Works [Latest Version]
- C. State of Washington
 1. Chapter 173-303 WAC, Dangerous Waste Regulations, Chapter 173-304 WAC, Minimum Functional Standards for Solid Waste Handling
- D. Washington Department of Ecology
 1. Construction Stormwater General Permit, Issued November 16, 2005

13.2 ENVIRONMENTAL MITIGATION PLAN

- A. Prior to commencing work, prepare and submit to the Owner a detailed Environmental Mitigation Plan showing the Contractor's mitigation measures proposed for compliance with the environmental protection requirements imposed by the specifications and all Agencies Having Jurisdiction (AHJ) over the site. The Contractor is solely responsible for working with AHJ to gain approval of the mitigation plan. The plan shall contain review comments and, if applicable, approval from AHJ. The Plan shall include, but not be limited to:
 - The requirements for handling and disposal of recycled materials, waste materials, and hazardous materials (reference hazardous materials survey and environmental site assessment reports);
 - Waste management plan;
 - Proposed haul routes;
 - Air emission control measures to be used during performance of the work;
 - Noise plan,

13.3 AIR POLLUTION CONTROL

- A. Do not discharge smoke, dust, or other contaminants into the atmosphere that violate the regulations of legally constituted Agencies. Minimize dust nuisance by cleaning, sweeping, and sprinkling with water, or other means. The use of water in amounts which result in mud on public streets is not acceptable as a substitute for sweeping or other methods.

13.4 NOISE CONTROL

- A. Comply with local controls and noise level rules, regulations, and ordinances that apply to work performed pursuant to the contract.

GENERAL CONDITIONS

- B. Hours of operation shall be limited to that of AHJ

PART 14 - PROJECT CLOSEOUT

14.1 CLOSEOUT PROTOCOL

- A. Follow the protocol established at the Project Closeout Planning Meeting.

14.2 PUNCH LIST PROCEDURE

- A. Substantial Completion will be granted with the issuance of the punchlist. The type of punch list items remaining are anticipated to be items that have been ordered and are in route. However, the Contractor shall establish and follow, well before Substantial Completion, a punch process following at least the requirements below, to ensure completion of the Project by the dates listed in the Project Milestones.
- B. The Owner will prepare a Punch List spreadsheet form, and give it to the Contractor in electronic format. Column headings will include:
 - 1. who created that item (Contractor, AHJ, Designer, etc.)
 - 2. location
 - 3. item description
 - 4. responsibility (Prime, which sub, etc.)
 - 5. date when Contractor intends to complete the item
 - 6. date completed.
 - 7. completion signoff (Contractor's initials)
 - 8. notes
- C. The Contractor shall create an initial Punch List of the Project areas, listing known items yet to be completed. The Punch List shall include all, if any, outstanding AHJ items and list minor known items yet to be completed. - The Contractor shall forward the Punch List in electronic format to the Owner when requesting a punch review.
- D. The Owner (and/or the Owner's Consultants) will perform a punch review of the improvements when requested by the Contractor for punch review, and will use the Contractor-provided Punch List, adding additional items to be completed, if any. The Owner and Owner's Consultants has the opportunity to join any punch review and contribute to the punch list. The Owner will consolidate the Owner's Consultants' punch lists with theirs and forward the revised Punch List electronically to the Contractor for action. This compiled list is the Punch List all parties shall use, from this point on.
- E. The Owner then performs a field walk, verifying whether the Contractor has completed the items on the Punch List, and adding any additional uncompleted work noted - resulting in a Back Punch List. The Owner shall forward the Back Punch List to the Contractor for completion.
- F. The Contractor contacts the Owner, when all Back Punch List items are completed. The Owner and/or Architect shall then perform a field walk, verifying whether the Contractor has completed the items on the Back Punch List. If the Owner does not agree that the items have been completed, the Contractor shall be directed to rectify incomplete items, and then repeat this item until all work is complete.
- G. All AHJ's approvals must have been granted before Substantial Completion can be granted. At the Owner's discretion, Substantial Completion may be granted with a few minor items that may have long lead times, remaining to be completed - as long as the Owner approves the Contractor's proposed date when all remaining minor items will be completed.

GENERAL CONDITIONS

- H. After the process above has been successfully completed for the project and the Owner has signed off that the Project area is ready for Substantial Completion, the Contractor may proceed with the Substantial Completion process.

14.3 SUBSTANTIAL COMPLETION

- A. Contractor shall request a determination of Substantial Completion as of a certain date once the contract document scope of work is complete and all required inspections have been approved.
- B. Once the site has been considered Substantially complete, the Architect will then prepare a Certificate of Substantial Completion for the Contractor's signature and the Owner's acceptance, attaching the few items remaining, if any.

14.4 CLEAN-UP

- A. Clean-up required for specific trades or work is specified in Sections pertaining to that trade or work.
- B. Provide Final Cleaning of the entire site, including all laydown and office areas.

14.5 WARRANTY

- A. The Contractor shall warrant to the Owner that all materials, workmanship and equipment provided for use under the Contract as a permanent part of this project will be new, free from faults and defects, and in compliance with the Contract Documents. The Contractor shall furnish, upon request, such documentation or evidence to support the quality of the material or equipment as in compliance with the Contract Documents.
- B. Contractor shall be responsible for correcting all defects in workmanship and material at its own expense, within one year after Substantial Completion of the Contract. Contractor shall start work to remedy such defects within seven (7) calendar days of written notice of discovery thereof by Owner and shall complete such work within the time stated in the notice. In emergencies, where damage may result from delay or where loss of services may result, such corrections may be made by Owner, in which case the cost shall be borne by Contractor. In the event Contractor does not accomplish corrections at the time specified, the work will be otherwise accomplished and the cost of same shall be paid by Contractor.
- C. Notwithstanding the one-year guarantee period, all other warranties and statutory responsibilities that extend beyond the one-year guarantee period shall remain in force.

PART 15 - PROJECT RECORD DOCUMENTS

15.1 GENERAL

- A. Specific requirements for Project Record Documents indicated in the Contract Documents must be in conformance with the Agencies Having Jurisdiction and the requirements of KCHA. All final required Record Documents, including but not limited to the following, must be on file with the Owner before the due date for Project Record Documents or the Final Completion Date, whichever comes first;
- Contractor Daily Reports
 - Daily QC Reports
 - Monthly Construction Progress Schedule
 - Testing documentation/ logs / final reports
 - Change Order backup and documentation

GENERAL CONDITIONS

- Operations and Maintenance Manuals
- Warranty & Guarantee Manual
- Record Drawings
- Photographs and Videos
- Permits
- Written summary of all tickets, logs, accountings, etc.
- All other documentation required by the Contract

Some of the key Record Documents are discussed in detail below.

- B. Final documents that must be prepared and submitted for review and discussion at the Project Closeout Planning Meeting.

15.2 RECORD DRAWINGS

- A. Continually record all addenda, change orders, and the actual installations on a set of full-size signed Construction Drawings kept readily available at the project during construction. This signed Construction Drawing set shall be used for this purpose alone, and shall be kept separate from other Drawings. Record Drawings shall indicate actual locations and elevations of all work installed by the Contractor that varies from Contract Documents.
- B. Record information concurrently with the progress of construction. No work shall be concealed until the required information is recorded.
- C. The Contractor shall account for red-line markups of Record Drawings on a monthly basis to show timely recording. Monthly payment will be contingent upon the Owner's positive affirmation of the status of the Record Drawings.
- D. The Record Drawings shall consist of a reproducible set of prints, with "as-built" conditions clearly and legibly scribed with waterproof red felt-tip pens, dark enough that the sheets can be reproduced. No highlighters, pencils, or ballpoint pens are allowed. Notations are to be neat, legible, clear and concise. If the Owner determines the notations are not legible, the Contractor shall correct them at its own expense.
- E. Final payment to the Contractor shall not be authorized until two complete sets of the completed Record Drawings have been submitted to the Owner and accepted by the Owner.
- F. A separate set of Specifications is to be kept with the Record Drawings. These Specifications shall be used solely for this Record Specifications purpose. Mark these Specifications to indicate all addenda and change orders, and mark them as such, including reference to the Field Directive and Change Order the revision was paid through. Mark the actual methods, materials, and installation where they vary from that indicated in Specifications and modifications issued. Note related Record Drawing information, where applicable. Give particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later.
- G. In each Specification Section where products, materials or units of equipment are specified or scheduled, mark the copy with the proprietary name and model number of the product furnished.
- H. Record the name of the manufacturer, supplier and installer, and other information necessary to provide a record of selections made and to document coordination with record Product Data submittals and maintenance manuals.
- I. Note related record Product Data, where applicable.

GENERAL CONDITIONS

- J. Final payment to the Contractor shall not be authorized until two complete sets of any changed pages to the Specifications have been submitted to the Owner and approved by the Owner.

15.3 PROJECT PHOTOS

A. Quality and Process

1. Photographs shall be taken at locations of active construction showing the Work. Photos shall cover all periods of construction, including but not limited to preconstruction, construction and postconstruction.
2. Photographs shall be in a digital format, and shall be in color. All photographs shall be date-stamped, and labeled with date taken, and specific location and activity, and labeled to show the appropriately named folders and files.
3. Submit a minimum of 20 photos each month covering the activities of the month. (Digital photos may be emailed to the Owner and Architect.)
4. At the end of the Project, compile and transmit all photos previously submitted, to the Owner.

B. Preconstruction Photographs

1. Provide preconstruction photographs prior to commencement of work on the site. Provide exposures of each area where the work is to take place, sufficient to document the preconstruction conditions.

C. Construction Photographs

1. Provide daily photographs during the progress of the work, for each work area, sufficient to cover the day's activities. Take daily exposures and continue as long as the work is in progress.

D. Postconstruction Photographs

1. Take photographs of the completed Work upon acceptance of the Work, sufficient to document the postconstruction conditions.

15.4 MISCELLANEOUS RECORD SUBMITTALS

Items listed below are representative, but not inclusive.

- A. In order to achieve Final Completion, complete miscellaneous records and place in good order, properly identified, ready for continued use and reference. Submit to Owner and Architect for project records. Coordinate with Part 14 Project Closeout. Items listed below are representative, but not inclusive:

1. Copies of all permits when issued and upon final approval by the Agency Having Jurisdiction.
2. File all affidavits by contractor and all subcontractors with L&I.
3. Materials and disposal receipts and trip tickets as applicable.
4. All required Operations and Maintenance Manuals.
5. All Warranties, where applicable.
6. As-Built Drawings
7. Record Drawings
8. Photographs

PART 16 - ADMINISTRATIVE PROVISIONS

GENERAL CONDITIONS

16.1 MEETINGS AND COORDINATION

- A. The Contractor is required to coordinate, schedule, and participate in preconstruction meetings with all Agencies Having Jurisdiction, including but not limited to King County Local Services; if they have jurisdiction over this Project. The Contractor shall give advance notice of such meetings to Owner, and invite them to the meetings.
- B. The Owner will conduct the Preconstruction Conference with the Contractor no later than five (5) business days after execution of Contract. The purpose of the meeting is to establish lines of authority and communication, and identify duties and responsibilities of the parties.
- C. Regular weekly progress meetings shall be on a schedule mutually decided on at the Preconstruction Conference. The Contractor will conduct the meetings, and will compile meeting notes to be furnished to all participants. The purpose of these meetings is to discuss schedule, submittals, and changes in the Work, ensure a full understanding of current project status and progress, updates/discussion on safety precautions and quality control actions, current & upcoming activities, and other contract requirements.
- D. A project close out meeting will be held at the midpoint of the Project, and shall be shown on the Contractor's Schedule. The purpose of this meeting is to present a proposed Closeout Schedule to a level of detail depicting testing, punch activities, completion of documentation and Record Documents, and all related activities for the final 20% of the overall schedule.
- E. Provide, administer, and use web-based project software to host and manage project communication and documentation. Include, at minimum, the following features:
 - 1. Project directory, including Owner, Contractor, subcontractors, Architect, Architect's consultants, and other entities involved in the project. Include names of contact persons and contact information for each entity.
 - 2. Access control for each entity and for each workflow process to determine each entity's digital rights to create, modify, view, and print documents.
 - 3. Workflow planning, allowing customization of workflow for each project entity.
 - 4. Creation, logging, tracking, and notification for project communications.
 - 5. Tracking of project communication statuses in real time, including timestamped response log.
 - 6. Processing and tracking of payment applications.
 - 7. Processing and tracking of contract modifications.
 - 8. Processing and tracking of submittals and submittal schedule
 - 9. Processing and tracking of meeting agendas and notes.
 - 10. Processing and tracking of RFIs
 - 11. Management of construction photographs
 - 12. Processing and tracking of construction schedules
- F. Cost: Contractor shall pay cost of service.
- G. Provide up to 20 user licenses for use by Owner, Architect, Owner's consultants, and other entities involved in the project.
- H. Training: Provide one-hour, web-based training session for users of software service. Further training is the responsibility of the user.
- I. Project Closeout: Owner determines when to terminate the software service for the project and contractor is responsible for providing archive copies of files to Owner.

GENERAL CONDITIONS

16.2 REPORTS AND SCHEDULES

- A. Prepare a daily construction report, to be submitted to the owner and architect on a weekly basis, recording the following information concerning events at Project site and project progress:
1. Date.
 2. High and low temperatures, and general weather conditions.
 3. List of subcontractors at Project site.
 4. List of separate contractors at Project site.
 5. Approximate count of personnel at Project site.
 6. Major equipment at Project site.
 7. Material deliveries.
 8. Safety, environmental, or industrial relations incidents.
 9. Meetings and significant decisions.
 10. unusual events (submit a separate special report).
 11. Testing and/or inspections performed.
- B. Construction Progress Schedule:
1. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
 2. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
 3. Within 20 days after review of preliminary schedule, submit draft of proposed complete Construction Progress Schedule for review.
 4. Within 10 days after joint review, submit complete Construction Progress Schedule.
 5. Submit updated critical path schedule with each Application for Payment.

16.3 QUALITY ASSURANCE:

- A. Contractor's Quality Control (CQC) Plan:
1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
 - a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority. Include qualifications, duties, responsibilities of each person assigned to CQC function.
 - b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
- B. Testing and inspection agencies and services.
1. Owner will employ and pay for services of an independent testing agency to perform special tests and inspections.

GENERAL CONDITIONS

2. Contractor shall employ and pay for services of an independent testing agency to perform all other required testing and inspections. This assignment of responsibility shall take precedence over assignment indicated in individual specification sections. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents. Agency shall be qualified with a minimum of 5 years of experience performing the types of tests and inspections required.
3. Contractor shall coordinate with all test and inspection agencies and schedule all required tests and inspections, including special tests and inspections.
4. The Contractor shall submit a written statement of responsibility to the building official, owner, and architect, prior to the commencement of work on systems or components requiring special tests and/or inspection. The contractor's statement of responsibility shall contain acknowledgement of awareness of the special requirements contained in the special inspection checklist and associated notes on the structural drawings.

PART 17 - MISCELLANEOUS PROVISIONS

17.1 RECORDS KEEPING AND REPORTING

- A. The Contractor and all Subcontractors shall maintain accounts and records in accordance with State Auditor's procedures, including personnel, property, financial and programmatic records which sufficiently and properly reflect all direct and indirect costs of any nature expended and services performed in the performance of this Contract and other such records as may be deemed necessary by the Owner to ensure proper accounting for all funds contributed by the Owner to the performance of this Contract and compliance with this Contract.
- B. The Contractor, and its Subcontractors, shall maintain these records for a period of six (6) years after the date of Final Acceptance.

17.2 AUDITS AND INSPECTIONS

- A. The records and documents with respect to all matters covered by this Contract shall be subject at all times to inspection, review or audit by the Owner or any other government agency so authorized by law during the performance of this Contract. The Owner shall have the right to an annual audit of the Contractor's financial statement and condition.

17.3 ORGANIZATION CONFLICTS OF INTEREST

- A. The Contractor warrants that to the best of its knowledge and belief and except as otherwise disclosed, it does not have any organizational conflict of interest which is defined as a situation in which the nature of work under this Contract and the Contractor's organizational, financial, contractual or other interests are such that:
 1. Award of the Contract may result in an unfair competitive advantage; or
 2. The Contractor's objectivity in performing the Contract work may be impaired.
- B. The Contractor agrees that if after award they discover an organizational conflict of interest with respect to this Contract, they shall make an immediate and full disclosure in writing to the Contracting Officer, which shall include a description of the action, which the Contractor has taken or intends to take to eliminate or neutralize the conflict. The Owner may, however, terminate the Contract if it deems the action to be in the best interest of the Owner.
- C. In the event the Contractor was aware of an organizational conflict of interest before the award of this Contract and intentionally did not disclose the conflict to the Contracting Officer, the Owner may terminate the Contract for default.

GENERAL CONDITIONS

- D. The provisions of this Clause shall be included in all subcontracts and consulting agreements wherein the work to be performed is similar to the services provided by the Contractor. The Contractor shall include in such subcontracts and consulting agreements any necessary provisions to eliminate or neutralize conflicts of interest.

17.4 INTERESTS OF MEMBERS OF CONGRESS

- A. No member of or delegate to the Congress of the United States of America shall be admitted to any share or part of this Contract or to any benefit to arise therefrom, but this provision shall not be construed to extend to this Contract if made with a corporation for its general benefit.

17.5 INTERESTS OF MEMBERS, OFFICERS, COMMISSIONERS AND EMPLOYEES, OR FORMER MEMBERS, OFFICERS AND EMPLOYEES

- A. No member, officer, or employee of the King County Housing Authority, no member of the governing body of the locality in which the project is situated, no member of the governing body in which the Owner was activated, and no other public official or such locality or localities who exercises any functions or responsibilities with respect to the project, shall, during his or her tenure, or for one year thereafter, have any interest, direct or indirect, in this Contract or the proceeds thereof.

BID FORM

PROJECT NAME AND LOCATION:

Skyway Resource Center Renovations

Contract Number: SP2300150

BID FORM

The undersigned, Legal Name of Bidder: _____

on this date: _____, 2023, having familiarized him/herself with the contract documents, site conditions, and has field verified all measurements contained in the project manual as prepared by the Owner, hereby proposes to furnish labor, materials and necessary equipment – all including, but not limited to, demolition, disposal, new installation and the required applicable taxes and fees to complete the work for the following bid amounts:

BASE BID _____ (\$ _____)
(Including sales tax indicated in Instructions to Bidders)

ADDITIVE ALTERNATE BID #1: COMMON AREA FURNISHINGS

_____ (\$ _____)
(Including sales tax indicated in Instructions to Bidders)

ADDITIVE ALTERNATE BID #2: LANDSCAPE PLANTINGS & IRRIGATION EXTENSTIONS

_____ (\$ _____)
(Including sales tax indicated in Instructions to Bidders)

ALTERNATE BID# 3: LIFT TO SECOND FLOOR

_____ (\$ _____)
(Including sales tax indicated in Instructions to Bidders)

TOTAL BID AMOUNT FOR ALL ITEMS ABOVE

_____ (\$ _____)
(Including sales tax indicated in Instructions to Bidders)

ADDENDA _____

Acknowledge receipt of any addenda by inserting the number(s) above

BID FORM

In submitting this bid, it is understood that the right is reserved by the Owner to reject any and all bids. The undersigned hereby agrees that this proposal shall be a valid and firm offer for a period of One Hundred Twenty (120) calendar days from the date of Bid Opening.

Bidder agrees that Work will be substantially complete and ready for final payment in accordance with the Contract Documents on or before the date, within the number of calendar days indicated.

The undersigned Bidder hereby certifies that, within the three-year period immediately preceding the bid solicitation date for this Project, the bidder is not a “willful” violator, as defined in RCW 49.48.082, of any provision of chapters 49.46, 49.48, or 49.52 RCW, as determined by a final and binding citation and notice of assessment issued by the Department of Labor and Industries or through a civil judgment entered by a court of limited or general jurisdiction.

I certify (or declare) under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct.

Signature of Bidder

Print Your Name

Submitted on _____ day of _____ 2023

City

State

BIDDER INFORMATION

BIDDER INFORMATION

Name of Bidder (Company): _____

Address: _____

Contact Name: _____

Phone Number: _____ Email Address: _____

Business Type: General Contractor () Other () (Please specify): _____

Bidder is a(n): Individual Partnership Joint Venture Incorporated in the state of _____

List business names & associated UBI # used by Bidder during the past 5 years if different than above:

Bidder has been in business continuously from: _____
Month, Year

Business License #: _____ Federal ID #: _____

Current UBI #: _____ Dept. of L&I Worker's Comp. Acct. #: _____

Bidder has experience in work "Similar in Scope and Complexity" comparable to that required for this Project:

As a prime contractor for _____ years. As a subcontractor for _____ years.

OWNER(S) OF COMPANY (List all owners):	OWNER'S SOCIAL SECURITY NUMBER (only required if sole proprietorship):

No. of regular full-time employees other than owner(s): _____

Indicate clearly the kind of work your company will actually perform in this project:

Approximate % of work your company will actually perform:

List the supervisory personnel to be employed by the Bidder and available for, and intended to, work on this project:

<u>Name</u>	<u>Title</u>	<u>How Long With Bidder</u>

BIDDER INFORMATION

SUBCONTRACTORS

Do you intend to use Subcontractor(s) in this project? Yes No See Instructions to Bidders, Part 1.3, C

Subcontractors Name	Subcontractor's UBI#	Phone Number	Trade	Years in Business
1.			HVAC	
2.			PLUMBING	
3.			ELECTRICAL	
4.				
5.				
6.				
7.				
8.				

BIDDER'S EXPERIENCE

Projects successfully supervised and completed by your company for work of similar scope and value as specified in bid documents in the last 5 years. Attach additional pages as necessary.

Name of Project	Completion Date	Duration (Months)	Nature of Work	Amount of Contract
1.				
2.				
3.				
4.				
5.				

Owner's Name (of project listed above)	Project Address	Contact Person	Phone Number
1.			
2.			
3.			
4.			
5.			

Has Bidder ever been found guilty of violating any State or Federal employment laws? No Yes

If yes, give details & attach additional pages as necessary: _____

BIDDER INFORMATION

Has Bidder ever filed for protection under any provision of the federal bankruptcy laws or state insolvency laws?

No Yes. If yes, give details & attach additional pages as necessary: _____

Has any lien, claim and/or adverse legal action related to construction been rendered against Bidder in the past five years? (i.e., open claims, lawsuits, warrants, judgements including but not limited to those that would show on the L&I website) No Yes. If yes, give details & attach additional pages as necessary: _____

Has Bidder or any of its employees filed any claims with Washington State Worker's Compensation or other insurance company for accidents resulting in fatal injury or dismemberment in the past 5 years? No Yes.

If yes, please state:

<u>Date</u>	<u>Type of Injury</u>	<u>Agency Receiving Claim</u>
-------------	-----------------------	-------------------------------

_____	_____	_____
_____	_____	_____

Bidders current Experience Modification Rate (EMR): _____

(If Bidder is self-insured, attach proof of EMR stated, showing complete worksheet calculations)

The bidder hereby certifies that the information contained in this Bidder's Information is accurate, complete and current.

BY: _____ NAME: _____
(signature) (print)

TITLE: _____ DATE: _____

**Skyway Resource Center
Redevelopment**

12610 76th Ave South, Seattle, WA 98178

Agreement to Pay Prevailing Wages

Contractor certifies that all workers, laborers, or mechanics employed in the performance of any part of the Work shall be paid the prevailing rate of wages to in accordance with the requirements of the Owner and the Wage Rate Schedule.
Form must be filed with the Owner prior to commencement of Work.

Company Details

Company Name	
Address	
Contractor Registration No.	
WA UBI Number	
Phone Number	
Industrial Insurance Account ID	
Email Address	
Filed By	

Prime Contractor

Company Name	
Contractor Registration No.	
WA UBI Number	
Phone Number	

Project Information

Contract Number	SP2300150
Project Name	Skyway Resource Center Redevelopment
Contract Amount	
Project Site Address	12610 76 th Ave S., Seattle, WA 98178

Intent Details

Expected project start date: (MM-DD-YYYY)	
Does your company intend to hire ANY subcontractors?	
Will your company have employees perform work on this project?	
Do you intend to use any apprentices? (Apprentices are considered employees.)	

Journey Level Wages

County	Trade	Wage	Fringe	# Workers

Apprentice Level Wages

Step	Trade	Wage %	Wage	Fringe	# Workers

Signature: _____

Print Name: _____

Date: _____

**Skyway Resource Center
Redevelopment**

12610 76th Ave South, Seattle, WA 98178

Affidavit of Wages Paid

Contractor certifies that all workers, laborers, or mechanics employed in the performance of any part of the Work have been paid the prevailing rate of wages to in accordance with the requirements of the Owner and the Wage Rate Schedule.
Form must be filed with the Owner prior to Final Acceptance.

Company Details

Company Name	
Address	
Contractor Registration No.	
WA UBI Number	
Phone Number	
Industrial Insurance Account ID	
Email Address	
Filed By	

Project Information

Contract Number	SP2300150
Project Name	Skyway Resource Center Redevelopment
Contract Amount	
Project Site Address	12610 76 th Ave S., Seattle, WA 98178
Prime Contractor Name	
Prime Contractor Registration No.	
Prime Contractor Phone Number	
Dollar Amount of Your Contract	
Job Start Date: MM-DD-YYYY	
Date Work Completed: MM-DD-YYYY	

Project Completion

Did your company hire any subcontractors?	
Did your company have employees perform work on this project?	
Did you use any apprentices on this job? (Apprentices are considered employees.)	

Project Subcontractors

Company Name	Primary Contact	Phone	UBI

Journey Level Wages

County	Trade	Wage	Fringe	# Workers

Apprentice Level Wages

Step	Trade	Wage %	Wage	Fringe	# Workers

Signature: _____

Print Name: _____

Date: _____

CONTRACT FORM

This Contract is entered into by and between the King County Housing Authority, hereinafter referred to as the “Owner” whose principal office is located at 600 Andover Park West, Tukwila, WA 98188 and [Name of Contractor], referred to as the “Contractor”, whose principal office is located at [Contractor’s Address].

IN CONSIDERATION OF the mutual benefits and conditions hereinafter contained, the parties hereto agree as follows:

1.1 Contract Documents

A. The provisions set forth in the Contract Documents are hereby incorporated into and made part of the Contract. Contractor acknowledges receipt and review of all Contract Documents applicable to performance of the work. The Contract shall consist of the following component parts:

1. This Instrument
2. Bid Addenda
3. Specifications
4. Construction Drawings/Plans
5. Bid Form
6. Pre-Bid Agenda
7. General Conditions
8. Instructions to Bidders
9. Agreement to Pay Prevailing Wage
10. Performance and Payment Bonds
11. King County Special Inspections Checklist (see structural drawings for related requirements)
12. Hazardous Material Report dated June, 2022
13. Phase I Environmental Site Assessment dated June, 2021
14. Limited Sub-Slab Soil Vapor Investigation Report dated January, 2022

1.2 Scope of Services to be Performed by the Contractor: The Contractor shall provide all labor, materials, tools, equipment, transportation, supplies, and incidentals required to complete the work in accordance with the Contract Documents for:

Project: Skyway Resource Center Redevelopment

Contract No.: SP2300150

1.3 Compensation: The total amount of the Contract shall be [\$\$] dollars and [¢¢] cents (\$[\$\$\$.\$\$\$]) subject to additions and deductions provided therein.

1.4 Duration of Contract: The Contractor shall commence work after receipt of Notice to Proceed, follow the schedule specified in the contract documents, and all work must be completed within two hundred seventy (270) consecutive calendar days from the date of the Notice to Proceed unless sooner terminated pursuant to the General Conditions. Upon expiration of the original Contract term, the Contract, at the Owner’s sole discretion, may be extended for a period determined by the Owner.

1.5 Liquidated Damages: Timely performance and completion of the Work is essential to Owner and time limits stated in the Contract Documents are of the essence. If Completion of the Work does not occur within the Contract Time, the Contractor agrees that Liquidated Damages in the amount of **\$2,000** per day will be assessed for each calendar day that the Contractor exceeds the time for completion.

The individuals signing this Contract warrant and represent for themselves and for their respective organizations that they are duly authorized to sign this Contract and that upon such signing their respective organizations are bound thereby.

DATED this _____ day of _____, 2023

Contractor

Owner

President/Owner

[Name of Signer]

[Title of Signer]

KING COUNTY HOUSING AUTHORITY

CERTIFICATE OF INSURANCE

DATE(MM/DD/YY)

Issue Date

PRODUCER Vendor's Insurance Agent Street Address City, State, Zip Phone Number	THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.
COMPANIES AFFORDING COVERAGE	
COMPANY A	ABC Insurance Company

INSURED Vendor Name Street Address City, State, Zip	COMPANY B DEF Insurance Company
	COMPANY C GHI Insurance Company
	COMPANY D

COVERAGES
 THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS
A	GENERAL LIABILITY	XXX123	01/01/00	01/01/01	GENERAL AGGREGATE 2,000,000
	<input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY				PRODUCTS-COMP/OP AGG 1,000,000
	<input type="checkbox"/> CLAIMS MADE <input checked="" type="checkbox"/> OCCUR				PERSONAL & ADV INJURY 1,000,000
	<input type="checkbox"/> OWNER'S & CONTRACTOR'S PROT				EACH OCCURRENCE 1,000,000
					FIRE DAMAGE (Any one fire) 50,000
					MED EXP (Any one person) 5,000
B	AUTOMOBILE LIABILITY	XXX456	01/01/00	01/01/01	COMBINED SINGLE LIMIT 1,000,000
	<input checked="" type="checkbox"/> ANY AUTO				BODILY INJURY (Per person)
	<input type="checkbox"/> ALL OWNED AUTOS				BODILY INJURY (Per accident)
	<input checked="" type="checkbox"/> HIRED AUTOS				PROPERTY DAMAGE
<input type="checkbox"/> SCHEDULED AUTOS					
<input type="checkbox"/> NON-OWNED AUTOS					
	GARAGE LIABILITY				AUTO ONLY-EA ACCIDENT
	<input type="checkbox"/> ANY AUTO				OTHER THAN AUTO ONLY:
					EACH ACCIDENT
					AGGREGATE
C	EXCESS LIABILITY				EACH OCCURRENCE 5,000,000
	<input checked="" type="checkbox"/> UMBRELLA FORM				AGGREGATE 5,000,000
	<input type="checkbox"/> OTHER THAN UMBRELLA FORM				
D	WORKERS' COMPENSATION AND EMPLOYER'S LIABILITY	XXX789	01/01/00	01/01/01	<input checked="" type="checkbox"/> STATUTORY LIMITS
	<input type="checkbox"/> THE PROPRIETOR/PARTNERS/EXECUTIVE OFFICERS ARE:				EACH ACCIDENT 1,000,000
	<input type="checkbox"/> INCL				DISEASE-POLICY LIMIT 1,000,000
	<input type="checkbox"/> EXCL				DISEASE-EACH EMPLOYEE 1,000,000
	OTHER				

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS
King County Housing Authority is named as additional insureds with respect to above general liability and auto coverages. Re: Insured's work/services provided at Skyway Resource Center, 12610 76th Ave S., Seattle, WA 98178.

CERTIFICATE HOLDER King County Housing Authority 600 Andover Park West, Tukwila, WA 98188-3326	CANCELLATION SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE COMPANY, ITS AGENTS OR REPRESENTATIVES. AUTHORIZED REPRESENTATIVE Signature of Insured's Agent
--	---

PROVIDE

**GENERAL LIABILITY
ENDORSEMENT**

and

**AUTO LIABILITY
ENDORSEMENT**

FIELD DIRECTIVE

Skyway Resource Center Redevelopment

King County Housing Authority
600 Andover Park West
Tukwila, WA 98188

FD No.: # _____
Date: _____
Contract No.: SP2300150

Contractor: _____

The Contractor is hereby instructed to proceed as follows:

It is agreed that work associated with this Change Order shall be accomplished:

- With no change to contract price.
- A Not-to-Exceed value of \$_____. This Field Authorization represents a limited notice to proceed. The Contractor is obligated not to exceed this amount without additional written authorization from King County Housing Authority. The final cost for the work associated with this Field Authorization shall be reconciled by Change Order.

Cost Data shall be supported by one of the following methods in accordance with the General Conditions.

- Fixed Price
- Unit Price (Bid items if applicable: _____)
- Actual Cost of labor, materials and equipment, along with other job related costs necessary to accomplish work
- Other: _____

It is further agreed that the work shall affect Contract Time as follows:

- With no change on Substantial Completion date.
- With _____(____) days added to the Substantial Completion date.

Contractor Acceptance:

Owner's Representative Approval:

Project Manager

Project Manager

Date: _____

Date: _____

SPECIAL INSPECTION CHECKLIST



Permit Number(s): ADDC23-0007

The Owner or the Owner's Authorized Agent, other than the Contractor, shall employ one or more approved agencies to provide special inspections and tests during construction as specified in IBC Section 1705.

SPECIAL INSPECTION DOES NOT ELIMINATE REGULAR INSPECTIONS

The Special Inspector shall furnish inspection reports to the Building Official and to the Registered Design Professional in Responsible Charge. Discrepancies shall be brought to the immediate attention of the Contractor for correction. **Unless otherwise agreed, all reports furnished to the Building Official shall be forwarded electronically to:**

buildinginspections.dper@kingcounty.gov

Final report letter(s) documenting the required special inspections shall be approved by the Building Inspector prior to occupancy.

SEE GENERAL STRUCTURAL NOTES FOR MORE INFORMATION: _____

STRUCTURAL OBSERVATION

By Engineer of Record per IBC Section 1704.6. Submit letter prior to occupancy.

SITE AND FOUNDATION

- See "Geotechnical Report" attached
- Soil Bearing _____ PSF
- Special Grading, Excavation, and Fill

PILING/PIERS

- Driving and testing of piles and construction of cast-in-place drilled piles or caissons
- Soil nail and/or tieback installation and testing

STEEL CONSTRUCTION

- Structural Steel High Strength Bolts
- Connections Metal Panel Shear Walls
- Lateral Bracing Metal Building Systems
- Welding (WABO certified welders and/or accredited shop required, or equivalent)

CONCRETE CONSTRUCTION

- Structural design based on specified compressive strength greater than 2,500 psi
- Concrete (mix selection, placement, consolidation)
- Reinforcing Steel Expansion Bolts
- Bolts/Threaded Anchors Epoxy Anchors
- Holdown Hardware Embedded Items
- Precast Members Shotcrete
- Post-Tensioning (placement and stressing)

MASONRY CONSTRUCTION

- Prisms, placement of units, reinforcing, grout space, and grout placement
- Periodic inspection when design stresses have been adjusted to permit non-continuous inspection and only where specifically allowed by the engineer
- Bolts, Anchors, and/or Embedded Items

WOOD CONSTRUCTION

- Cross-Lam Timber Bolts Strong Walls
- Holdowns/Straps Hangers/Connectors
- Shear Nailing at: Walls Floors Roofs

FIREPROOFING

- Spray-On Mastics Intumescent
- Firestopping Systems

MECHANICAL SYSTEMS

- System Balancing for: Kitchen Hood(s) Supply/Return Air Outside Air
- Pressurization at: Stairways Elevators

ENERGY SYSTEMS

- Building Air Leakage Lighting Controls

MISCELLANEOUS: _____

919 Southwest Grady Way, Suite 300 Renton, WA 98057

Telephone (206) 296-6600 TTY 711

Modified 07/11/2022

SKYWAY RESOURCE CENTER

Contract# SP2300150

12610 76th Ave Seattle, WA 98178

PROJECT MANUAL – VOLUME 4 SPECIFICATIONS

Owner: King County Housing Authority



600 Andover Park W.
Tukwila, WA 98188

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03 - Invitation to Bid

04 - Instructions to Bidders

05 - General Conditions

06 - Bid form and Bidder Information

07 - Sample Agreement to Pay Prevailing Wages

08 - Sample Affidavit of Wages Form

09 - Contract Form

10 - Sample Certificate of Insurance

11 - Sample Field Directive Form

12 - King County Special Inspections Checklist (see structural drawings for related requirements)

13 - Hazardous Materials Report dated June, 2022

14 - Phase 1 Environmental Site Assessment Report dated June, 2021

15 - Limited Sub-Slab Soil Vapor Investigation Report dated January, 2022

SPECIFICATIONS

DIVISION 02 -- EXISTING CONDITIONS

02 41 00 - Demolition

DIVISION 03 -- CONCRETE

03 30 00 - Cast-in-Place Concrete

03 35 11 - Concrete Floor Finishes

DIVISION 04 -- MASONRY

04 20 00 - Unit Masonry

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05 12 00 - Structural Steel

05 12 13 - Architecturally-Exposed Structural Steel Framing

05 50 00 - Metal Fabrications

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PROJECT
MANUAL
VOLUME 1

PROJECT MANUAL VOLUME 2
(INCLUDES 1ST HALF OF PHASE 1
ENVIRONMENTAL ASSESSMENT)

PROJECT MANUAL VOLUME 3
(INCLUDES 2ND HALF OF PHASE 1
ENVIRONMENTAL ASSESSMENT)

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06 10 00 - Rough Carpentry

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07 46 46 - Fiber Cement Siding

07 54 00 - Thermoplastic Membrane Roofing

07 62 00 - Sheet Metal Flashing and Trim

07 72 00 - Roof Accessories

07 92 00 - Joint Sealants

DIVISION 08 -- OPENINGS

08 06 71 - Door Hardware Schedule

08 11 13 - Hollow Metal Doors and Frames

08 14 16 - Flush Wood Doors

08 33 23 - Overhead Coiling Doors

08 43 13 - Aluminum-Framed Storefronts

08 51 13 - Aluminum Windows

08 62 23 - Tubular Skylights

08 71 00 - Door Hardware

08 80 00 - Glazing

DIVISION 09 -- FINISHES

09 05 61 - Common Work Results for Flooring Preparation

09 21 16 - Gypsum Board Assemblies

09 30 00 - Tiling

09 51 00 - Acoustical Ceilings

09 51 53 - Direct-Applied Acoustical Ceilings

09 54 26 - Suspended Wood Ceilings

09 65 00 - Resilient Flooring

09 66 13 - Portland Cement Terrazzo Flooring

09 68 13 - Tile Carpeting

- 09 72 00 - Wall Coverings
- 09 91 13 - Exterior Painting
- 09 91 23 - Interior Painting
- 09 93 00 - Staining and Transparent Finishing
- 09 96 00 - High-Performance Coatings

DIVISION 10 -- SPECIALTIES

- 10 14 00 - Signage
- 10 22 13 - Wire Mesh Partitions (For Exterior Trellis)
- 10 26 00 - Wall and Door Protection
- 10 28 00 - Toilet, Bath, and Utility Room Accessories
- 10 44 00 - Fire Protection Specialties
- 10 55 00 - Postal Specialties

DIVISION 11 -- EQUIPMENT

- 11 52 13 - Projection Screens

DIVISION 12 -- FURNISHINGS

- 12 24 00 - Window Shades
- 12 48 13 - Entrance Floor Mats and Frames
- 12 50 50 - Furniture

DIVISION 13 -- SPECIAL CONSTRUCTION (NOT USED)**DIVISION 14 -- CONVEYING EQUIPMENT**

- 14 42 00 - Wheelchair Lifts

DIVISION 21 -- FIRE SUPPRESSION (NOT USED)**DIVISION 22 -- PLUMBING**

- 22 05 13 - Common Motor Requirements for Plumbing Equipment
- 22 05 16 - Expansion Fittings and Loops for Plumbing Piping
- 22 05 19 - Meters and Gauges for Plumbing Piping
- 22 05 23 - General Duty Valves for Plumbing Piping
- 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment
- 22 05 53 - Identification for Plumbing Piping and Equipment
- 22 07 16 - Plumbing Equipment Insulation
- 22 07 19 - Plumbing Piping Insulation

22 07 19.11 - Under-lavatory Pipe and Supply Covers

22 10 05 - Plumbing Piping

22 30 00 - Plumbing Equipment

22 40 00 - Plumbing Fixtures

DIVISION 23 -- HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

23 05 29 - Hangers and Supports for HVAC Piping and Equipment

23 05 48 - Vibration and Seismic Controls for HVAC

23 05 53 - Identification for HVAC Piping and Equipment

23 05 93 - Testing, Adjusting, and Balancing for HVAC

23 07 13 - Duct Insulation

23 08 00 - Commissioning for HVAC

23 09 23 - 12 - Control Dampers

23 31 00 - HVAC Ducts and Casings

23 33 00 - Air Duct Accessories

23 37 13 - Diffusers, Registers, and Grilles

23 72 00 - Air-To-Air Energy Recovery Equipment

23 82 19 - Variable Refrigerant Flow HVAC System

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26 05 05 - Selective Demolition for Electrical

26 05 19 - Low-Voltage Electrical Power Conductors and Cables

26 05 26 - Grounding and Bonding for Electrical Systems

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26 05 33 - Conduit for Electrical Systems

26 05 33.16 - Boxes for Electrical Systems

26 05 36 - Cable Trays for Electrical Systems

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- 26 05 73 - Power System Studies
- 26 05 83 - Wiring Connections
- 26 09 23 - Lighting Control Devices
- 26 21 00 - Low-Voltage Electrical Service Entrance
- 26 22 00 - Low-Voltage Transformers
- 26 24 16 - Panelboards
- 26 25 13 - Low-Voltage Busways
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- 32 11 23 - Aggregate Base Courses
- 32 12 16 - Asphalt Paving
- 32 13 13 - Site Concrete Paving
- 32 17 13 - Parking Bumpers
- 32 1723.13 - Painted Pavement Markings

END OF SECTION

SECTION 02 41 00**DEMOLITION****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Selective demolition of built site elements.
- B. Selective removal and salvage of building and site elements.
- C. Selective demolition of building elements for alteration purposes.
- D. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

- A. Section 07 01 50.19 - Preparation for Re-Roofing: Removal of existing roofing, roof insulation, flashing, trim, and accessories.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2019.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Site Plan: Indicate:
 - 1. Vegetation to be protected.
 - 2. Areas for temporary construction and field offices.
 - 3. Areas for temporary and permanent placement of removed materials.
- C. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.
 - 1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
 - 2. Indicate items to be salvaged for the Owner.
 - 3. Demolition firm qualifications.
 - 4. Include a summary of safety procedures.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
 - 1. Minimum of 2 years of documented experience.

PART 2 PRODUCTS**PART 3 EXECUTION****3.01 DEMOLITION**

- A. Salvage the following items for reinstallation:
 - 1. Existing lobby light fixtures to be refurbished and reinstalled
 - 2. Existing safe deposit boxes for use by owner and/or artists in future installations
- B. Remove paving and curbs required to accomplish new work.
- C. Remove other paving and curbs as indicated on drawings.
- D. Remove concrete slabs on grade as indicated on drawings.
 - 1. Carefully protect the existing terrazzo flooring to remain.
 - 2. At slabs indicated to be removed, cut in straight lines to maintain crisp edge conditions for neat juncture with new slabs and flooring finishes.
- E. Remove other items indicated, for salvage, relocation, and recycling.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Use of explosives is not permitted.
 - 3. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 4. Provide, erect, and maintain temporary barriers and security devices.
 - 5. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 6. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 7. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
 - 8. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
 - 9. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements to remain in place and not removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.

- D. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- E. Comply with recommendations of owner provided hazardous material report. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- F. Perform demolition in a manner that maximizes salvage and recycling of materials.
 - 1. Comply with requirements of Section 01 74 19 - Construction Waste Management and Disposal.
 - 2. Dismantle existing construction and separate materials, arrange for credit for heavy timbers and brick in good condition.
 - 3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.
- G. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 EXISTING UTILITIES

- A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
 - 1. Verify construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.
- C. Remove existing work as indicated and required to accomplish new work.
 - 1. Remove items indicated on drawings.

- D. Services including, but not limited to, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications: Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.
- E. Protect existing work to remain.
 - 1. Prevent movement of structure. Provide shoring and bracing as required.
 - 2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch to match new work.

3.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove materials not to be reused on site; comply with requirements of Section 01 74 19 - Waste Management.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 03 30 00**CAST-IN-PLACE CONCRETE****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Concrete footings and foundations.
- B. Concrete slabs on grade.
- C. Sheet vapor barrier under concrete slabs on grade.
- D. Concrete reinforcement.
- E. Joint devices associated with concrete work.
- F. Concrete curing.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.
- B. Section 32 13 13 - Site Concrete Paving: Sidewalks, curbs and gutters.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- C. ACI 301 - Specifications for Structural Concrete; 2016.
- D. ACI 302.1R - Guide to Concrete Floor and Slab Construction; 2015.
- E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- F. ACI 306R - Guide to Cold Weather Concreting; 2016.
- G. ACI 308R - Guide to External Curing of Concrete; 2016.
- H. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2018).
- I. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.
- J. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.
- K. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
- L. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2020.
- M. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2020.

- N. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2015a.
- O. ASTM C150/C150M - Standard Specification for Portland Cement; 2020.
- P. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- Q. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019.
- R. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes; 2018.
- S. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2019.
- T. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2016.
- U. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.
- V. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2018.
- W. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.
- X. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for submittal requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
- C. Mix Design: Submit proposed concrete mix design.
 - 1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
 - 2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
- D. Samples: Submit two 6" x 6" samples of underslab vapor barrier to be used.
- E. Test Reports: Submit report for each test or series of tests specified.
- F. Manufacturer's Installation Instructions: For concrete accessories, including underslab vapor barrier, indicate installation procedures and interface required with adjacent construction.
- G. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 117, ACI 301 and ACI 318.
- B. Follow recommendations of ACI 306R when concreting during cold weather.
- C. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- D. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

1.06 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows:
 - 1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.07 WARRANTY

PART 2 PRODUCTS

2.01 REINFORCEMENT MATERIALS

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 - 1. Type: Deformed billet-steel bars.
 - 2. Finish: Unfinished, unless otherwise indicated.
- B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.
 - 1. Form: Coiled Rolls.

2. WWR Style: 6 x 6-W1.4 x W1.4.
- C. Reinforcement Accessories:
1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.02 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
1. Acquire cement for entire project from same source.
- B. Normal-Weight Aggregate: ASTM C 33, coarse aggregate or better, graded.
1. Acquire aggregates for entire project from same source.
 2. Maximum Coarse-Aggregate Size: 1 inch (25 mm).
- C. Fly Ash: ASTM C618, Class C or F.
- D. Water: ASTM C94/C94M, potable, clean, and not detrimental to concrete.

2.03 ADMIXTURES

- A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement. Do not use calcium chloride or admixtures containing calcium chloride.
- B. Air Entrainment Admixture: ASTM C260/C260M.
- C. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
- D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
- E. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
- F. Retarding Admixture: ASTM C494/C494M Type B.
- G. Water Reducing Admixture: ASTM C494/C494M Type A.
- H. Moisture Vapor Reducing Admixture (MVRA): Liquid, inorganic admixture free of volatile organic compounds (VOCs). Closes capillary systems formed during concrete curing to reduce moisture vapor emission and transmission. Reduces concrete shrinkage with no adverse effect on concrete properties or applied flooring.

2.04 ACCESSORY MATERIALS

- A. Underslab Vapor Barrier : A 15-mil multi-layer plastic extrusion sheet, manufactured with high grade, polyolefin resins, complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
1. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.

2. Products:
 - a. Stego Industries, LLC; Stego Wrap Vapor Barrier: www.stegoindustries.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Non-Shrink Epoxy Grout: Per structural drawings.
 1. Composition: High solids content material exhibiting positive expansion when tested in accordance with ASTM C827/C827M.
 - a. Maximum Height Change: Plus 4 percent.
 - b. Minimum Height Change: Plus 1 percent.
 2. Minimum Compressive Strength at 7 days, ASTM C579: 12,000 pounds per square inch.

2.05 BONDING AND JOINTING PRODUCTS

- A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.
- B. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
 1. Material: ASTM D1751, cellulose fiber.

2.06 CURING MATERIALS

- A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
 1. Products:
 - a. Dayton Superior Corporation[]: www.daytonsuperior.com/#sle.
 - b. Euclid Chemical Company ; EUCOBAR: www.euclidchemical.com/#sle.
 - c. Kaufman Products Inc; VaporAid: www.kaufmanproducts.net/#sle.
 - d. W. R. Meadows, Inc ; Evapre or Evapre-RTU: www.wrmeadows.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 - B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
 1. Product dissipates within 4 to 6 weeks.
 2. Products:
 - a. Dayton Superior Corporation[]: www.daytonsuperior.com/#sle.
 - b. Euclid Chemical Company; Kurez W VOX: www.euclidchemical.com/#sle.
 - c. Kaufman Products Inc; Thinfilm 420 Resin Base: www.kaufmanproducts.net/#sle.
 - d. SpecChem, LLC; SpecRez Clear: www.specchemllc.com/#sle.
 - e. W. R. Meadows, Inc; 1100-Clear: www.wrmeadows.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
 - C. Water: Potable, not detrimental to concrete.

2.07 CONCRETE MIX DESIGN

- A. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- B. Normal Weight Concrete:
 - 1. Strength per structural drawings.
 - 2. Fly Ash Content: Maximum 20 percent of cementitious materials by weight, complying with ASTM C618.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.
- B. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

3.02 PREPARATION

- A. Verify that forms are clean and free of rust before applying release agent.
- B. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- C. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in accordance with bonding agent manufacturer's instructions.
 - 1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
 - 2. Use latex bonding agent only for non-load-bearing applications.
- D. Where new concrete with integral waterproofing is to be bonded to previously placed concrete, prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions. Saturate cold joint surface with clean water, and remove excess water before application of coat of waterproofing admixture slurry. Apply slurry coat uniformly with semi-stiff bristle brush at rate recommended by waterproofing manufacturer.
- E. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- F. Interior Slabs on Grade: Install vapor barrier under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor barrier before covering.
 - 1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor barrier as indicated on drawings. Do not use sand.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

- B. Install welded wire reinforcement in maximum possible lengths on bar supports spaced to minimize sagging, and offset end laps in both directions. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps and splice laps with tie wire.
- C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 VAPOR BARRIERS

- A. Sheet Vapor Barriers: Place, protect, and repair sheet vapor barriers under interior slabs on grade; lap sheet over footings and seal to foundation walls according to ASTM E1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
 - 2. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
 - 3. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
 - 4. Repair damaged vapor retarder before covering with other materials.

3.05 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Notify Architect not less than 24 hours prior to commencement of placement operations.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
- G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.06 SLAB JOINTING

- A. Locate joints as indicated on drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
 - 1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
- D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.

- E. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.
- F. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

3.07 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. Maximum Variation of Surface Flatness:
 - 1. Exposed Concrete Floors: 1/4 inch in 10 feet.
 - 2. Under Seamless Resilient Flooring: 1/4 inch in 10 feet.
 - 3. Under Carpeting: 1/4 inch in 10 feet.
- B. Correct the slab surface if tolerances are less than specified.
- C. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.08 CONCRETE FINISHING

- A. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
 - 1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI 302.1R; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with full bed setting system.
 - 2. Decorative Exposed Surfaces: "Steel trowel" as described in ACI 302.1R; use steel-reinforced plastic trowel blades instead of steel blades to avoid black-burnish marks; decorative exposed surfaces include surfaces to be stained or dyed, pigmented concrete, surfaces to be polished, and all other slab surfaces.
 - 3. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.
- B. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

3.09 CURING AND PROTECTION

- A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Surfaces Not in Contact with Forms:
 - 1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
 - 2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.

3. Final Curing: Begin after initial curing but before surface is dry.

3.10 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.
- F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.
- H. Slab Testing: Cooperate with manufacturer of specified moisture vapor reducing admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.

3.11 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.12 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

SECTION 03 35 11**CONCRETE FLOOR FINISHES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Surface treatments for concrete floors and slabs.
- B. Liquid densifiers and hardeners.
- C. Clear coatings.
- D. Clear penetrating sealers.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.
- B. Section 09 66 13 - Portland Cement Terrazzo Flooring

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with concrete floor placement and concrete floor curing.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for submittal requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.05 MOCK-UP

- A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.
- B. Mock-Up Size: 10 feet square.
- C. Locate where directed by Owner.
- D. Mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.07 FIELD CONDITIONS

- A. Protect slabs from time of placement until Substantial Completion.
 - 1. Diaper hydraulic powered equipment to avoid staining concrete.
 - 2. Do not allow vehicles to park on slab. If necessary to complete their scope of work, drop cloths will be placed under vehicles at all times.

3. No pipe cutting machines permitted on slab.
 4. Steel will not be placed on interior slab to avoid rust staining.
 5. Wheeled equipment must be equipped with non-marking tires.
- B. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.
 - C. Do not finish floors until interior heating system is operational.
 - D. Maintain ambient temperature of 50 degrees F minimum.

PART 2 PRODUCTS

2.01 CONCRETE FLOOR FINISH APPLICATIONS

2.02 COATINGS

- A. Low Gloss Clear Coating: Transparent, nonyellowing, acrylic polymer-based coating.
 1. Composition: Solvent-based.
 2. Composition: Water-based.
 - a. Nonvolatile Content: 20 percent, minimum, when measured by volume.
 - b. Products:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL

- A. Apply materials in accordance with manufacturer's instructions.

3.03 COATING APPLICATION

- A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.
- C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
- D. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION

SECTION 04 20 00**UNIT MASONRY****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Concrete block.
- B. Mortar and grout.
- C. Reinforcement and anchorage.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Loose steel lintels and Fabricated steel items.
- B. Section 07 21 00 - Thermal Insulation: Spray foam insulation applied to masonry faces.
- C. Section 07 25 00 - Air and Weather Barriers: Water-resistive barriers applied to exterior face of backing sheathing or unit masonry substrate.

1.03 REFERENCE STANDARDS

- A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.
- B. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2016, with Editorial Revision (2018).
- C. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2016a.
- D. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- E. ASTM C150/C150M - Standard Specification for Portland Cement; 2020.
- F. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- G. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019.
- H. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.
- I. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting 2 weeks before starting work of this section; require attendance by all relevant installers.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for submittal requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide data for masonry units, mortar, and masonry accessories.
- C. Manufacturer's Certificate: Certify that masonry unit net-area compressive strength (f'm) meets or exceeds specified requirements.

- D. Shop Drawings:
1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
- E. Mix Designs:
1. Provide one of the following for each mortar mix:
 - a. Mix designs indicating type and proportions of ingredients in compliance with the Proportion Specifications of ASTM C 270; or,
 - b. Mix designs and results of mortar tests performed in accordance with the Property Specifications of ASTM C 270.
 2. Provide one of the following for each grout mix:
 - a. Mix designs indicating type and proportions of the ingredients according to the proportion requirements of ASTM C 476; or,
 - b. Mix designs and results of grout strength tests performed in accordance with ASTM C 476; or,
 - c. Results of compressive strength tests performed in accordance with ASTM C 1019, and slump flow and visual stability index (VSI) as determined by ASTM C 1611.
 3. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.06 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depth of 8 inches.
 2. Load-Bearing Units: ASTM C90, medium weight.
 - a. Hollow block, as indicated.
 - b. Pattern: To match custom pattern of existing masonry.

2.02 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I.
1. Not more than 0.60 percent alkali.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Mortar Aggregate: ASTM C144.
- D. Grout Aggregate: ASTM C404.

- E. Water: Clean and potable.

2.03 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; uncoated.
- B. Single Wythe Joint Reinforcement: ASTM A951/A951M.

2.04 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Property Specification.
 - 1. Masonry below grade and in contact with earth: Type M or S.
 - 2. Exterior, loadbearing masonry: Type S.
 - 3. Exterior, non-loadbearing masonry: Type O.
- B. Grout for Unit Masonry: Conform to IBC requirements. Verify strength by unit strength method in accordance with TMS 602-16

2.05 MASONRY CLEANER

- A. Clear liquid concentrated acidic cleaner for dissolving mortar smears and construction dirt on brick, tile and concrete surfaces.
 - 1. Basis of Design: Prosoco; Sure Klean 600; www.prosoco.com.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.04 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: To match custom pattern of existing masonry.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.

3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- E. Interlock intersections and external corners.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Cut mortar joints flush where wall tile is scheduled, resilient base is scheduled, or cavity insulation vapor barrier adhesive is applied.
- I. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.06 CUTTING AND FITTING

- A. Cut and fit for Modified Door Opening, and as required to match existing masonry pattern at patch of existing hole in wall. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.07 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean masonry surfaces with specified cleaning solution per manufacturer's instructions.
- D. Use non-metallic tools in cleaning operations.

3.08 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 05 12 00**STRUCTURAL STEEL FRAMING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Structural steel framing members.
- B. Structural steel support members.
- C. Base plates, shear stud connectors.
- D. Grouting under base plates.

1.02 RELATED REQUIREMENTS

- A. Section 05 03 00 - Conservation Treatment for Period Metals for cleaning and restoring existing steel structure.
- B. Section 05 12 13 - Architecturally-Exposed Structural Steel Framing: Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).
- C. Section 05 50 00 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.03 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.
- B. Exposed Structural Steel: Members and connections exposed to view as indicated in the Contract Documents, or in this Specification.

1.04 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual; 2017.
- B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.
- E. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2018.
- F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- G. ASTM A242/A242M - Standard Specification for High-Strength Low-Alloy Structural Steel; 2013 (Reapproved 2018).
- H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014, with Editorial Revision (2017).
- I. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2020.

- J. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
- K. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011 (Reapproved 2015).
- L. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- M. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film; 2017.
- N. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2019.
- O. ASTM E165/E165M - Standard Test Method for Liquid Penetrant Examination for General Industry; 2018.
- P. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2015.
- Q. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2018.
- R. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- S. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
- T. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; 2018.
- U. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2014, with Errata (2015).
- V. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- W. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- X. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- Y. SSPC-SP 2 - Hand Tool Cleaning; 2018.
- Z. SSPC-SP 3 - Power Tool Cleaning; 2018.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for submittal requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Shop Drawings:
 - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
 - 2. Connections not detailed.
 - 3. Indicate cambers and loads.
 - 4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
- D. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
- E. Fabricator Test Reports: Comply with ASTM A1011/A1011M.

- F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
- G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.06 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
- B. Maintain one copy of each document on site.
- C. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience, and registered with and approved by the City of Seattle.
- D. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.
- E. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
- F. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.
- G. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel." In addition, all welders performing shop or field-welding of structural steel members shall be WABO certified, or equivalent, as accepted by the Structural Engineer and Building Official

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steel Angles and Channels: ASTM A36/A36M.
- B. Steel W Shapes and Tees: ASTM A992/A992M.
- C. Rolled Steel Structural Shapes: ASTM A992/A992M.
- D. Steel Plates and Bars: ASTM A36/A36M
- E. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade C.
- F. Hot-Formed Structural Tubing: ASTM A501/A501M, seamless or welded. Grade B.
- G. Pipe: ASTM A53/A53M, Type E or S, Grade B, Finish black.
- H. Headed Anchor Rods: ASTM F1554, Grade 36, plain.
- I. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- J. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
 - 2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.

- K. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- L. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type II - Organic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- C. Fabricate connections for bolt, nut, and washer connectors.
- D. Develop required camber for members.

2.03 FINISH

- A. Prepare structural component surfaces in accordance with SSPC-SP 3.
- B. Shop prime structural steel members. Do not prime surfaces that will be field welded, in contact with concrete, or high strength bolted.

2.04 SOURCE QUALITY CONTROL

- A. Owner will engage a qualified independent testing and inspecting agency to perform shop tests and inspections and prepare test reports in accordance with IBC Chapter 17 and the Statement of Special Inspections in the General Structural Notes.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 - 2. At the Owner's discretion, structural steel inspections may be waived if approved by the Building Official for work performed on the premises of a fabricator registered and approved to perform such work without special inspection in accordance with IBC Section 1704.2.
- B. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least 25 percent of bolts at each connection.
- C. Welded Connections: Visually inspect all shop-welded connections and test at least 15 percent of welds according to AWS D1.1 using one of the following:
 - 1. Radiographic testing performed in accordance with ASTM E94/E94M.
 - 2. Ultrasonic testing performed in accordance with ASTM E164.
 - 3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
 - 4. Magnetic particle inspection performed in accordance with ASTM E709.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

- A. Erect structural steel in compliance with AISC 303.
- B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Field weld components and shear studs indicated on shop drawings. Remove paint and galvanizing prior to welding.
- D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".
- E. Do not field cut or alter structural members without approval of Architect.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least 25 percent of bolts at each connection.
- C. Welded Connections: Visually inspect all field-welded connections and test at least 15 percent of welds according to AWS D1.1 using one of the following:
 - 1. Radiographic testing performed in accordance with ASTM E94/E94M.
 - 2. Ultrasonic testing performed in accordance with ASTM E164.
 - 3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
 - 4. Magnetic particle inspection performed in accordance with ASTM E709.

END OF SECTION

SECTION 05 12 13**ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL FRAMING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS) .
- B. Cleaning and repairing of existing steel for exposed conditions.

1.02 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing: General requirements for structural steel members, including AESS framing specified in this section.
- B. Section 05 50 00 - Metal Fabrications: Loose steel bearing plates and miscellaneous steel framing.
- C. Section 09 91 13 - Exterior Painting: Finish coat requirements and coordination with primer and surface preparation specified in this section.
- D. Section 09 91 23 - Interior Painting: Finish coat requirements and coordination with primer and surface preparation specified in this section.
- E. Section 09 96 00 - High-Performance Coatings: Finish coat requirements and coordination with primer and surface preparation specified in this section.

1.03 DEFINITIONS

- A. Architecturally-Exposed Structural Steel: Structural steel complying with designated AESS category as defined in AISC 303.
- B. AISC categories for AESS are listed below. Refer to AISC 303 for full definitions.
 - 1. AESS 1: Basic elements.
 - 2. AESS 2: Feature elements viewed at a distance greater than 20 ft (6 m).
 - 3. AESS 3: Feature elements viewed at a distance less than 20 ft (6 m).
 - 4. AESS 4: Showcase elements with special surface and edge treatment beyond fabrication.
 - 5. AESS C: Custom elements with characteristics described in the contract documents.

1.04 REFERENCE STANDARDS

- A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.
- B. AISC 360 - Specification for Structural Steel Buildings; 2016.
- C. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2019.
- D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2020.
- E. ASTM A1085/A1085M - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS); 2015.

- F. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2019.
- G. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
- I. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- J. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Schedule and conduct a preinstallation meeting at project site one week prior to start of work of this section; require attendance by all affected installers. Coordinate mock-up review with preinstallation meeting. Agenda will include requirements for shipping, special handling, storage, attachment of safety cables and temporary erection bracing, final coating, touch-up painting, mock-up, Architect's mock-up observations, and other requirements for AESS.

1.06 SUBMITTALS

- A. See Division 1 Project Administration for submittal requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product data for each type of product specified.
 - 1. Submit paint systems in accordance with Section 09 91 13.
- C. Shop Drawings: Detailing for fabrication of AESS components.
 - 1. Provide erection documents clearly indicating which members are AESS members and the AESS category of each part.
 - 2. Include details that clearly identify AESS requirements found in this specification. Provide connections for AESS consistent with concepts shown on drawings.
 - 3. Indicate welds by AWS A2.4 symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined by the designated AESS category.

1.07 QUALITY ASSURANCE

- A. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work..

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Comply with Section 05 12 00, except as amended in this section for aesthetic purposes.

2.02 FABRICATION

- A. Fabricate and assemble AESS in shop to greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by Architect. Detail AESS assemblies to minimize field handling and expedite erection.
- B. Permissible tolerances for member depth, width, out of square, and camber and sweep to be as specified in ASTM A6/A6M, ASTM A500/A500M, and ASTM A1085/A1085M.
- C. Use special care in handling and shipping of AESS both before and after shop painting to minimize damage to any shop finish. Use nylon-type slings or softeners when using chains or wire rope slings.
- D. Welded Connections:
 - 1. Comply with AWS D1.1/D1.1M and Section 05 12 00.
- E. Surface Preparation:
 - 1. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
 - 2. For existing steel to be refinished: Remove all existing paint and finishes, clean all rust spots with a wire brush, and treat with a rust inhibitor. Prepare for new paint finish.
- F. Fabricate AESS in accordance with categories defined in AISC 303, as follows:
 - 1. AESS 1: Basic elements.
 - 2. AESS 2: Feature elements viewed at a distance greater than 20 feet (feature elements not in close view).
 - 3. AESS 3: Feature elements viewed at a distance less than 20 feet (feature elements in close view).
 - 4. AESS 4: Showcase elements with special surface and edge treatment beyond fabrication (showcase elements).
 - 5. AESS C: Custom elements; fabricate to requirements of AESS 1 and the following characteristics:

2.03 PAINT SYSTEM

- A. Compatibility: All components/procedures of AESS paint system to comply with coating system specified, submitted, and approved per Sections 09 96 00. As a minimum, identify required surface preparation, primer, intermediate coat (if applicable), and finish coat. Primer, intermediate coating, and finish coating to be from a single manufacturer combined in a system documented by manufacturer with adequate guidance for fabricator to procure and execute.
- B. Primer: As specified in Sections 09 91 13, 09 91 23, and 09 96 00. Primer to comply with all federal standards for VOC, lead and chromate levels.

2.04 SHOP PRIMING

- A. Surface Preparation:
 - 1. Provide surface preparations to meet SSPC-SP 6.
 - 2. Coordinate required surface profile with approved paint submittal prior to beginning surface preparation.
 - 3. Prior to blasting, remove any grease and oil using solvent cleaning to meet SSPC-SP 1.
 - 4. Remove weld spatter, slivers and similar surface discontinuities.
 - 5. Ease sharp corners resulting from shearing, flame cutting or grinding.

- B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted with slip-critical connections.
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.05 MATERIALS

- A. General: Meet requirements of 05 12 00 as amended below.
- B. Tension Control, High-Strength Bolts, Nuts, and Washers: Per section 05 12 00, Tension Control Bolts. Provide standard carbon steel finish rounded bolt heads with twist off bolts; ASTM F3125/F3125M.

2.06 SOURCE QUALITY CONTROL

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Structural Requirements:
 - 1. Comply with quality control requirements per AISC 360, Chapter N and AISC 303, Section 10. Refer to Section 05 12 00 for additional requirements.
- C. AESS 1 and 2 Acceptance: Architect to observe AESS in the shop at a viewing distance consistent with final installation and determine acceptability based on qualification data and submittals. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.
- D. AESS 3,4, and C Acceptance: Architect to observe AESS in the shop at a viewing distance consistent with final installation and determine acceptability based on approved mock-up. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Erector to check all AESS members upon delivery for twist, kinks, gouges or other imperfections which may result in rejection of appearance of member. Coordinate remedial action with fabricator prior to erecting steel.

3.02 PREPARATION

- A. Provide connections for temporary shoring, bracing and supports only where noted on approved fabrication documents. Temporary connections not shown are to be made at locations not exposed to view in final structure or as approved by Architect.
- B. Handle, lift and align pieces using nylon straps or chains with softeners required to maintain appearance of AESS through process of erection.

3.03 ERECTION

- A. AESS 1 and 2: Basic elements; feature elements not in close view:
 - 1. Employ special care to handle and erect AESS. Erect finished pieces using nylon straps or chains with softeners such that they are not damaged.

2. Place weld tabs for temporary bracing and safety cabling at points concealed from view in completed structure or where approved by Architect during pre-installation meeting. Obtain Architect approval of methods for removing temporary devices and finishing AESS members prior to erection.
 3. AESS Erection Tolerances: Erect to standard frame tolerances for structural steel per Chapter 7 of AISC 303.
 4. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 5. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
 6. Remove all backing and run out tabs.
 7. When temporary braces or fixtures are required to facilitate erection, take care to avoid any blemishes, holes or unsightly surfaces resulting from use or removal of such temporary elements.
 8. Bolted Connections: Align bolt heads on same side of connection as indicated on approved fabrication or erection documents.
 9. Welded Connections: Comply with AWS D1.1/D1.1M and Section 05 12 00. Appearance and quality of welds to be consistent. Employ methods that will maintain alignment of members without warp exceeding tolerance of this section.
 10. Remove weld spatter exposed to view.
 11. Grind off projections larger than 1/16 inch at field butt and plug welds.
 12. Continuous Welds: Where continuous welding is noted on drawings, provide continuous welds of a uniform size and profile.
 13. Do not enlarge holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts. Replace connection plates that are misaligned where holes cannot be aligned with acceptable final appearance.
 14. Splice members only where indicated.
 15. Obtain permission for any torch cutting or field fabrication from Architect. Finish sections thermally cut during erection to a surface appearance consistent with mock-up.
- B. AESS 3: Feature elements in close view:
1. Erect to requirements of AESS 1 and 2 and as follows:
 2. Field Welding: Weld profile, quality, and finish to be consistent with mock-ups approved prior to fabrication.
 3. Provide a continuous appearance to all welded joints including tack welds. Provide joint filler at intermittent welds.
- C. AESS 4: Showcase elements:
1. Erect to requirements of AESS 3 and as follows:
 2. Grind welds smooth.
 3. Minimize Weld Show Through: At locations where welding on far side of an exposed connection creates distortion, grind distortion and marking of steel to a smooth profile with adjacent material.
 4. Filling of Weld Access Holes: Where holes must be cut in web at intersection with flanges on W shapes and structural tees to permit field welding of flanges, fill holes with joint filler.

5. Where welds are indicated to be ground, contoured, or blended, oversize welds as required and grind to provide a smooth transition and match profile on approved mock-up.

3.04 CLEANING

- A. Touch-up Painting: Complete cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint to blend with adjacent surfaces of AESS. Perform touch-up work in accordance with manufacturer's instructions and as specified in Section 09 91 13, 09 91 23, and 09 96 00.

END OF SECTION

SECTION 05 50 00**METAL FABRICATIONS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Shop fabricated steel items, including:
 - 1. Metal gratings for sun shade
 - 2. Other miscellaneous, sill angles, sleeves, inserts, anchors, framing and bracing members which are required for installation of metal fabrications, or form a component part of assemblies indicated; provide with finish as indicated or incorporation into work under related sections.
- B. Products furnished but not installed under this Section:
 - 1. Anchor bolts, steel pipe sleeves, and slotted-channel inserts indicated to be cast into concrete.
 - 2. Steel weld plates and angles (embeds) for casting into concrete for applications where they are not specified in other Sections.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 05 51 00 - Metal Stairs. Steel stairs, including associated handrails and guardrails.
- C. Section 09 91 13 - Exterior Painting: Paint finish.
- D. Section 09 91 23 - Interior Painting: Paint finish.
- E. Section 09 96 00 - High-Performance Coatings: Shop and field applied systems, including surface preparation, primers, finish coats, and field touch-up.
- F. Section 12 48 13 - Entrance Floor Mats and Frames: Entry gratings.
- G. Section 32 33 00 - Site Furnishings: Steel pipe bollards to match other site furnishings.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014, with Editorial Revision (2017).
- F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.

- G. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2016.
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- J. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2019.
- K. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
- M. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; 2018.
- N. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- O. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.04 SUBMITTALS

- A. See Division 1 Project Administration for submittal requirements and procedures. Refer to BIDPACKAGE for these GENERAL REQUIREMENTS.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Drawings shall show type and grade or strength of steel for each fabrication item.
 - 2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 3. Indicate all bolted and mechanically fastened connections showing type, alloy, and size of fasteners.
 - 4. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by others.
 - 5. For tubular sections to receive hot-dip galvanizing after fabrication, show sizes and locations of all vent and drain holes in accordance with ASTM A385 recommendations.
- C. Product Data: Submit product data for pre-manufactured components and shop applied primer and field applied repair coating for galvanizing. Submit procedures for following:
 - 1. Removing and reapplication of galvanized coating where fielding welding is required.
- D. Design Data Where materials or fabrications are indicated to comply with certain requirements for design loading, include structural data computations, material properties and other information needed for structural analysis certified by registered professional engineer, licensed to practice structural engineering in jurisdiction where Project is located to indicate compliance.
- E. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
- F. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

PART 2 PRODUCTS**2.01 MATERIALS - STEEL**

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Stainless Steel Tubing: ASTM A554, Type 304, 16 gauge, 0.0625 inch minimum metal thickness, 1-1/2 inch diameter.
- F. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
- G. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.
- H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- I. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS

- A. Metal Grating:
 - 1. Locations:
 - a. Sun Shade
 - 2. Steel Grating:
 - a. NAAMM Grating Mark 11-W-4 (1.5 x 1/8) STEEL: 1 1/2-by-1/8-inch bearing bars at 11/16 inch o.c., and crossbars at 4 inches o.c.; hot-dip galvanized.
 - b. Frames: Provide with welded frame with concrete anchors, depth to match full depth of grating; hot-dip galvanized.
 - 3. Fabrication: Fabricate floor gratings as removable sections.
 - 4. Provide no fewer than four weld lugs for each grating section composed of rectangular bearing bars 3/16 inch or less in thickness and spaced less than 15/16 inch o.c., with each lug shop welded to

three or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.

5. Fabricate with banding bars attached by welding to entire perimeter of each section.
6. Furnish threaded bolts with nuts and washers for securing grating to supports.

2.04 FINISHES - STEEL

- A. Prime paint all steel items.
 1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry.
 2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items with factory applied finishes.
- B. Prepare surfaces to be primed in accordance with SSP-SP3.
- C. Prime Painting: Two coats.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.
- C. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- D. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including threaded fasteners for concrete and masonry inserts, and other connectors as required.
- D. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plus, level, true and free of rack, measured from established lines and levels.

1. Provide temporary bracing or anchors in formwork for items which are to be built into concrete masonry or similar construction.
- E. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
1. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.
- G. Obtain approval prior to site cutting or making adjustments not scheduled.
- H. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

END OF SECTION

SECTION 05 51 00**METAL STAIRS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Stairs with concrete treads; exterior exit stairs.
- B. Stairs with floating wood treads; interior stairs.
- C. Cane Rail at interior stair.
- D. Structural steel stair framing and supports; refer to structural drawings
- E. Handrails and guards for stairs in this section.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal anchors in concrete footing per structural.
- B. Section 05 50 00 - Metal Fabrications. Fabrication and placement of miscellaneous, anchors and bracing members required for installation of metal stairs.
- C. Section 09 91 23 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- G. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014, with Editorial Revision (2017).
- H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2020.
- I. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
- J. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2018.

- K. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- L. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2019.
- M. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- N. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
- O. NAAMM AMP 510 - Metal Stairs Manual; 1992.
- P. NAAMM MBG 531 - Metal Bar Grating Manual; 2017.
- Q. NAAMM MBG 532 - Heavy Duty Metal Bar Grating Manual; 2009.
- R. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- S. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- T. SSPC-SP 2 - Hand Tool Cleaning; 2018.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for submittal requirements and procedures. Refer to BIDPACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide wood and metal samples.
- C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Include the design engineer's seal and signature on each sheet of shop drawings.
- D. Design Data: As required by authorities having jurisdiction.
- E. Welders' Certificates.
- F. Designer's Qualification Statement.
- G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 201.

1.05 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in Washington, or personnel under direct supervision of such an engineer. Comply with IBC 2018, with Washington State Amendments.
- B. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.
- C. Fabricator Qualifications:

1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
- D. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Stairs:
 1. Pacific Stair Corporation; precast stair with picket rails: www.ddpconcrete.com/cantilever-tread
 2. Viewrail; Flight Mono system with Vedera glass rail for commercial applications: <https://www.viewrail.com/>.

2.02 METAL STAIRS - GENERAL

- A. Contractor shall be responsible for procuring and coordinating the final design of the stairs. Coordinate all work requirements for with the manufacturer requirements. Contractor is responsible for the final installation.
- B. Provide stairs of the design drawn and specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
 1. Regulatory Requirements: Provide stairs and railings that comply with most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
 2. Handrails: Comply with applicable accessibility requirements of ADA Standards.
 3. Structural Design: Provide complete stair and railing assemblies that comply with the applicable local code.
 4. Dimensions: As indicated on drawings.
 5. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
 6. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
 7. Separate dissimilar metals using paint or permanent tape.
- C. Metal Jointing and Finish Quality Levels:
 1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
 - a. Welded Joints: Continuously welded and ground smooth and flush.
 - b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
 - c. Exposed Edges and Corners: Eased to small uniform radius.
 - d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.
- D. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- E. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.03 METAL STAIRS WITH CONCRETE TREADS (EXTERIOR)

- A. Jointing and Finish Quality Level: Architectural, as defined above.
- B. Treads and landing: Integral precast concrete treads and landing with partial closed riser.
 - 1. Basis of Design:
 - a. Diamond Design Precast: Cantilevered Half Riser Stair Tread, with mounting brackets embeds for rail attachment, designed for mounting to single centered carriage rail.
 - b. Puget Sound Precast, 19405 63rd Ave NE, Arlington, WA 98223; Phone: (360) 435-6151; Website: <https://www.ddpconcrete.com>
 - 2. Precast Concrete Tread Thickness: 1-1/2 inches, minimum / tread formed with thickend center that tapers toward ends to allow cantilevered mounting to center carriage beam.
 - 3. Precast Concrete Treads and landing:
 - a. Concrete Strength: 4,000 psi at 28 days, minimum.
 - b. Air Content: 4 to 6 percent.
 - c. Cement Color: Neutral Gray with exposed aggregate finish..
 - 4. Anchorage to Center Carriage: Welded to carrier angles welded to carriage beam.
- C. Stringers: Single HSS tube carriage beam centered on treads.
 - 1. Stringer Depth: As indicated on drawings.
- D. Landings: Similar precast concrete construction, supported and reinforced as required to achieve design load capacity.
- E. Railings: Steel picket railings; refer to drawings.
- F. Finish: Concrete sealer.

2.04 METAL STAIRS WITH WOOD TREADS (INTERIOR)

- A. Jointing and Finish Quality Level: Architectural, as defined above.
- B. Basis of Design: Viewrail Flight Mono System with Vedera Glass Railing.
 - 1. Contractor to coordinate and install stair system per manufacturer requirements and structural engineering drawings and calculations.
 - 2. Footing and blocking (wall and landing) attachment hardware shall be concealed.
- C. Treads: 3" Thick Wood; assume Hard Maple with dark stain to coordinate with existing wood stain on site, and as approved by the architect from samples provided. Provide matching end caps to conceal glass rail mounting hardware cut from same wood slab as tread - install with grain pattern aligned with tread grain.
 - 1. Provide tread grip strips; Three stainless steel metal strips.
 - 2. Risers: Laminated glass integral with tread; 3/8" thick.
- D. Stringers: centered HSS carriage rail per drawings; minimum 8" x 10"
 - 1. Anchorage to stringers: carrier angles welded to stringers to support wood treads
 - 2. Finish: Factory Powder Coat; If field welding is required, grind exposed welds smooth and touch-up with field paint to match.

- E. Landings: Same construction as treads, matching wood material and end caps at mid-landing.
- F. Railings: Tempered floating glass, with integral, concealed hardware. Provide matching wood square cap.
 - 1. Glass railing system shall extend to the upper landing per drawings. Use Glass Railing Base Rail
 - 2. Provide stainless steel round handrail with grab rail brackets intended for glass railing, as required.
- G. Cane Rail: Stainless steel rounded tube per the drawings
 - 1. Provide anchorage to the floor with stainless steel escutcons.

2.05 HANDRAILS AND GUARDS

- A. Guards at exterior metal stairs:
 - 1. Top Rails: Painted square steel tube rails unless otherwise indicated.
 - a. Outside Dimensions: 1 1/2" inch, minimum, to 1-1/2 inches, maximum.
 - 2. Infill at Picket Railings: Painted steel vertical pickets; refer to drawings.
 - a. Horizontal Spacing: Maximum 4 inches on center / space evenly so two pickets align with each tread as shown on drawings.
 - b. Material: HSS tube
 - c. Shape: Square.
 - d. Size: 1 3/4 inch square.
 - e. Top Mounting: Welded to underside of top rail.
 - f. Bottom Mounting: Welded to embeds on sides of treads and landing.
 - 3. End and Intermediate Posts: Same material and size as top rails.
 - a. Horizontal Spacing: As indicated on drawings.
 - b. Mounting: Welded to embeds at sides of treads and landing
- B. Guards at interior stairs:
 - 1. Laminated tempered float glass; low-iron, ultra clear.
 - a. Hidden fasteners, integrated with floating wood stair treads
 - b. Wood cap rail; no exposed hardware
 - c. Stainless steel handrail

2.06 MATERIALS

- A. Steel Sections: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.
- C. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
- D. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
 - 1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
 - 2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).
- E. Glazing: Laminated tempered float glass; clear.

2.07 ACCESSORIES

- A. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
- B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- C. Shop and Touch-Up Primer: SSPC-Paint 15, and comply with VOC limitations of authorities having jurisdiction.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, and comply with VOC limitations of authorities having jurisdiction.

2.08 SHOP FINISHING

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Prime Painting: Use specified shop- and touch-up primer.
 - 1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.
 - 2. Number of Coats: One.
- C. Galvanizing: Hot-dip galvanize to minimum requirements of ASTM A123/A123M.
 - 1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. When field welding is required, clean and strip primed steel items to bare metal.
- B. Supply items required to be cast into concrete and embedded in masonry with setting templates.

3.03 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors, plates, angles, and hangers required for connecting stairs to structure.
- C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
- F. Obtain approval prior to site cutting or creating adjustments not scheduled.
- G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION

SECTION 06 10 00**ROUGH CARPENTRY****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Structural dimension lumber framing.
- B. Nonstructural dimension lumber framing.
- C. Rough opening framing for doors, windows, and roof openings.
- D. Sheathing.
- E. Subflooring.
- F. Roof-mounted curbs.
- G. Roofing nailers.
- H. Preservative treated wood materials.
- I. Miscellaneous framing and sheathing.
- J. Communications and electrical room mounting boards.
- K. Concealed wood blocking, nailers, and supports.
- L. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Setting anchors in concrete.
- B. Section 05 12 00 - Structural Steel Framing: Prefabricated beams and columns for support of wood framing.
- C. Section 05 50 00 - Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing.
- D. Section 06 15 00 - Wood Decking.
- E. Section 06 17 33 - Wood I-Joists.
- F. Section 07 25 00 - Air and Weather Barriers: Water-resistive barrier over sheathing.
- G. Section 07 25 00 - Air and Weather Barriers: Air / weather barrier over sheathing.
- H. Section 07 62 00 - Sheet Metal Flashing and Trim: Sill flashings.
- I. Section 07 72 00 - Roof Accessories: Prefabricated roof curbs.
- J. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- C. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- D. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- F. AWPA U1 - Use Category System: User Specification for Treated Wood; 2018.
- G. PS 1 - Structural Plywood; 2009.
- H. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2010.
- I. PS 20 - American Softwood Lumber Standard; 2020.
- J. WWPA G-5 - Western Lumber Grading Rules; 2017.

1.04 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Timber: Lumber of 5 inches nominal or greater in least dimension.
- C. Engineered Wood:
 - 1. LVL: Laminated Veneer Lumber
 - 2. PSL: Parallel Strand Lumber
- D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. WCLIB: West Coast Lumber Inspection Bureau.
 - 2. WWPA: Western Wood Products Association.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for submittal requirements and procedures. Refer to BIDPACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide technical data on wood preservative materials and application instructions.
- C. Structural Composite Lumber: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if structural composite lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.
- D. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS**2.01 GENERAL REQUIREMENTS**

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Douglas Fir #2 or better, unless otherwise indicated.
 - 2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
 - 3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
 - 4. Provide dressed lumber, S4S, unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Western Wood Products Association; WWPA G-5.
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: Kiln-dry or MC15.
- D. Stud Framing (2 by 2 through 2 by 6):
 - 1. Exterior walls:
 - a. Stud size as indicated in drawings
 - b. Stud spacing 16 inches on center, advanced framing where possible
 - 2. Interior walls:
 - a. Stud size as indicated in drawings
 - 3. Species: Per Structural Drawings.
 - 4. Grade: Per Structural Drawings.
- E. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16):
 - 1. Interior beams over doorways shall be sawn lumber.
 - 2. Flush framed beams and rim boards shall be engineered lumber products.
 - 3. Roof Framing:
 - a. As indicated in drawings
 - 4. Floor Framing:
 - a. As indicated in drawings
 - 5. Species: Per Structural Drawings.
 - 6. Grade: Per Structural Drawings.
- F. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 STRUCTURAL COMPOSITE LUMBER

- A. At Contractor's option, structural composite lumber may be substituted for concealed dimension lumber and timbers.
- B. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.

2.04 CONSTRUCTION PANELS

- A. Subflooring: Any PS 2 type, rated Plywood Sheathing. See structural drawings.
 - 1. Bond Classification: Exterior.
 - 2. Span Rating: See structural drawings.
 - 3. Performance Category: see structural drawings PERF CAT.
- B. Roof Sheathing: Any PS 2 type, rated Plywood Sheathing. See structural drawings.
 - 1. Bond Classification: Exterior.
 - 2. Span Rating: See structural drawings.
 - 3. Performance Category: see structural drawings PERF CAT.
- C. Wall Sheathing: Plywood, PS 1, Grade Per structural drawings.
- D. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.05 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 2. Nails, Brads, and Staples: ASTM F 1667.
 - 3. Power-Driven Fasteners: NES NER-272.
 - 4. Wood Screws: ASME B18.6.1.
 - 5. Lag Bolts: ASME B18.2.1
 - 6. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
 - 7. Expansion Anchors: Use only expansion bolts listed in General Structural Notes.
- B. Joist Hangers, Holdowns, Hurricane Clips and Miscellaneous Light Gage Connectors: Hot dipped galvanized steel, sized to suit framing conditions, and subject to compliance with requirements listed in General Structural Notes.
 - 1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.
- C. Sill Gasket on Top of Foundation Wall or concrete slab: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.
- D. Subfloor Adhesives: Gap-filling construction adhesive for bonding wood structural panels to wood-based floor system framing; complying with ASTM D3498.

- E. Water-Resistive Barrier: See Section 07 25 00.
- F. Building Paper: Water resistant Kraft paper.

2.06 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

PART 3 EXECUTION

3.01 PREPARATION

- A. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.
- B. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FRAMING INSTALLATION

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.
- E. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.
- G. Framed Walls : Provide single bottom plate (unless double bottom plates are shown on the drawings) and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions. Fasten plates to supporting construction, unless otherwise indicated.
 - 1. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.

- H. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.
- I. Frame openings in accordance with the following requirements:
 - 1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
 - 2. For load-bearing walls, see Structural Drawings.
- J. Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as follows:
 - 1. Where supported on wood members, by toe nailing or by using metal framing anchors.
 - 2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.
 - 3. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than 1/3 depth of joist; do not locate closer than 2 inches from top or bottom.
 - 4. Provide solid blocking between joists under jamb studs for openings.

3.04 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- D. Provide the following specific nonstructural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Towel and bath accessories.
 - 6. Wall-mounted door stops.
 - 7. Chalkboards and marker boards.
 - 8. Wall paneling and trim.
 - 9. Joints of rigid wall coverings that occur between studs.

3.05 INSTALLATION OF CONSTRUCTION PANELS

- A. Subflooring: Glue and nail to framing; staples are not permitted.
 - 1. Space panels 1/8" apart at edges and ends.
- B. Underlayment: Secure to subflooring with nails and glue.

1. At locations where resilient flooring will be installed, fill and sand splits, gaps, and rough areas.
 2. Place building paper between floor underlayment and subflooring.
- C. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
1. At long edges use sheathing clips where joints occur between roof framing members.
 2. Nail panels to framing; staples are not permitted.
 3. Space panels 1/8" apart at edges and ends.
- D. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
1. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 2. Install adjacent boards without gaps.
 3. Size and Location: As indicated on drawings.
 4. Refer to Section 09 91 23 Interior Painting for backboard finish.

3.06 CLEANING

- A. Waste Disposal: See Division 1 Project Administration for requirements and procedures. Refer to BIDPACKAGE for these GENERAL REQUIREMENTS.
1. Comply with applicable regulations.
 2. Do not burn scrap on project site.
 3. Do not burn scraps that have been pressure treated.
 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 41 00**ARCHITECTURAL WOOD CASEWORK****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Specially fabricated cabinet units.
- B. Countertops.
- C. Hardware.
- D. Factory finishing.
- E. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2018).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2017, with Errata (2019).
- C. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.
- D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for submittal requirements and procedures. Refer to BIDPACKAGE for these GENERAL REQUIREMENTS.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
- E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.08 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Single Source Responsibility: Provide and install this work from single fabricator.

2.02 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.

2.03 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.

2.04 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica Corporation: www.formica.com/#sle.
 - 2. Wilsonart LLC: www.wilsonart.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Provide specific types as indicated.
 - 1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, color as selected, finish as selected.
 - 2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, color as selected, finish as selected.

2.05 COUNTERTOPS

- A. Plastic Laminate Countertops: Medium density fiberboard substrate covered with HPDL, conventionally fabricated, with decorative aluminum edge.

2.06 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Aluminum Edge Banding: Extruded convex shape; smooth surface finish; self locking serrated tongue; of width to match component thickness; natural mill finish.

- C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- D. Concealed Joint Fasteners: Threaded steel.
- E. Grommets: Standard plastic grommets for cut-outs, in color to match adjacent surface.

2.07 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Adjustable Shelf Supports: Standard side-mounted system using surface mounted metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
- C. Countertop Brackets: Fixed, concealed vertical leg, side-of-stud mounting.
- D. Drawer and Door Pulls: "U" shaped wire pull, steel with satin finish, 4 inch centers.
- E. Drawer Slides:
 - 1. Type: Full extension with overtravel.
 - 2. Static Load Capacity: Commercial grade.
 - 3. Mounting: Side mounted.
 - 4. Guides: 75 lb min rated
 - 5. Stops: Integral type.
 - 6. Features: Provide self closing/stay closed type.

2.08 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Locate counter butt joints minimum 2 feet from sink cut-outs.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

- B. Use fixture attachments in concealed locations for wall mounted components.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units.
- D. Secure cabinets to floor using appropriate angles and anchorages.
- E. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 01 50.19**PREPARATION FOR RE-ROOFING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Partial replacement of existing roofing system in preparation for replacement roofing system in designated areas as indicated on drawings.
- B. Removal of existing flashing and counterflashings.
- C. Temporary roofing protection.

1.02 RELATED REQUIREMENTS

- A. Section 07 54 00 - Thermoplastic Membrane Roofing.

1.03 REFERENCE STANDARDS**PART 2 PRODUCTS****2.01 COMPONENTS**

- A. See the following sections for additional information on components relating to this work:
 - 1. Partial removal of existing roofing system in preparation for new roofing system in designated areas as indicated on drawings, see Section 07 54 00.

2.02 MATERIALS

- A. Temporary Roofing Protection Materials:
 - 1. Contractor's responsibility to select appropriate materials for temporary protection of roofing areas as determined necessary for this work.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that existing roof surface has been cleared of materials being removed from existing roofing system and ready for next phase of work as required.

3.02 PREPARATION

- A. Sweep roof surface clean of loose matter.
- B. Remove loose refuse and dispose of properly off-site.

3.03 MATERIAL REMOVAL

- A. Remove metal counter flashings.
- B. Repair existing wood deck surface to provide smooth working surface for new roof system.

3.04 INSTALLATION

- A. Coordinate scope of this work with requirements for installation of new roofing system, see Section 07 54 00 for additional requirements.

3.05 PROTECTION

- A. Provide protection of existing roofing system that is not having work performed on it.

END OF SECTION

SECTION 07 21 00**THERMAL INSULATION****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Batt insulation in exterior wall construction.
- B. Sound-batt insulation in interior walls.
- C. Insulating foam sealant for filling perimeter window and door shim spaces and crevices in exterior wall and roof.
- D. Insulating foam sealant to fill exterior hollow metal frames and similar confined, inaccessible spaces in exterior construction.
- E. Closed-cell spray foam insulation in exterior wall and roof construction.
- F. Accessories for installation as indicated.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Supporting construction for batt insulation.
- B. Section 07 26 00 - Vapor Retarders: Separate vapor retarder materials.
- C. Section 07 25 00 - Air and Weather Barriers: Separate air barrier and vapor retarder materials.
- D. Section 07 54 00 - Thermoplastic Membrane Roofing: Insulation specified as part of roofing system.
- E. Section 09 21 16 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.
- B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- D. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.
- E. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.
- F. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

- I. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C; 2019a.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for submittal requirements and procedures. Refer to BIDPACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations for each type of product indicated.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.05 DELIVERY, STORAGE & HANDLING

- A. Protect insulation from physical damage and from deterioration by moisture, soiling and other sources. Store inside and in dry location. Comply with manufacturer's recommendations for handling, storage and protection during installation.

1.06 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.
- B. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate, nor when temperature is within 5 F of dew point.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Insulation on Inside of Concrete and Masonry Exterior Walls: Spray Applied Polyurethane Foam and Batt Insulation
- B. Insulation in Wood Framed Walls: Batt insulation. separate.
- C. Insulation at Roof: Spray Applied Polyurethane Foam (where indicated), and rigid board as specified with roof assembly

2.02 MINERAL FIBER BLANKET INSULATION MATERIALS

- A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
 1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 2. Formaldehyde Content: Zero.
 3. Thermal Resistance: Refer to R-values of assemblies in drawings.
 4. Products:
 - a. CertainTeed Corporation; CertainTeed Fiber Glass Insulation: www.certainteed.com.
 - b. Johns Manville; JM Fiber Glass Insulation: www.jm.com.

- c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
 5. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Mineral Fiber Sound Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 3. Products:
 - a. Johns Manville; MinWool Sound Attenuation Fire Batts: www.jm.com/#sle.
 - b. ROCKWOOL; COMFORTBATT: www.rockwool.com/#sle.
 - c. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.03 FOAMED-IN-PLACE INSULATION

- A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, two-component closed cell polyurethane spray foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
 1. Aged Thermal Resistance (R-value): 6.9 (deg F hr sq ft)/Btu, minimum, when tested at 1 inch thickness in accordance with ASTM C518 after aging for 180 days at 41 degrees F.
 2. Water Vapor Permeance: Vapor retarder; 2 perm, maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
 3. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
 4. Air Permeance: 0.004 cfm/sq ft, maximum, when tested at intended thickness in accordance with ASTM E2178 or ASTM E283 at 1.5 psf.
 5. Closed Cell Content: At least 90 percent.
 6. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
 7. Products:
 - a. CertainTeed; CertaSpray Closed Cell Foam: www.certainteed.com/insulation.
 - b. Bayer MaterialScience; Bayseal CC X: www.spf.bayermaterialscience.com.
 - c. Substitutions: See Section 01 60 00 - Material and Product Requirements.

2.04 ACCESSORIES

- A. Sheet Vapor Retarder: Specified in Section 07 25 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.03 FOAMED-IN-PLACE INSULATION

- A. Apply insulation in accordance with manufacturer's instructions.
- B. Apply insulation by spray method, to a uniform monolithic density without voids.
- C. Apply to achieve a thermal resistance R value as specified in assembly details.
- D. Patch damaged areas.
- E. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.

3.04 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 25 00**AIR AND WEATHER BARRIERS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Air/Weather Barriers: Materials that form a system to stop passage of air and water through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Vapor barrier under concrete slabs on grade.
- B. Section 06 10 00 - Rough Carpentry: Plywood sheathing to receive air/weather barrier.
- C. Section 07 54 00 - Thermoplastic Membrane Roofing: Vapor retarder installed as part of roofing system.
- D. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.
- E. Section 07 92 00 - Joint Sealants: Sealing building expansion joints.

1.03 DEFINITIONS

- A. Weather Barriers: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Air Barrier System: Components of the building enclosure, including the joints, junctures and transitions between materials, products, and assemblies forming the air-tightness of the building enclosure.
- C. Air Barrier (AB): Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.
- D. Vapor Retarder (VR): Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
 - 1. Water Vapor Permeance: For purposes of conversion, $57.2 \text{ ng}/(\text{Pa s sq m}) = 1 \text{ perm}$.
- E. Water-Resistive Barrier (WRB): Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams.
- F. Air/Weather Barrier (AWB): Air tight barrier made of material that is relatively air impermeable, is water vapor permeable, both to the degree specified, but sheds water and is moisture resistant, with sealed seams and with sealed joints to adjacent surfaces
- G. Self-Adhered Membrane Flashing (SAM): Flexible self-adhesive sheet flashing installed to shed water with sealed seams, and with sealed joints to adjacent surfaces.

1.04 REFERENCE STANDARDS

- A. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2019.

- B. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications; 2016.
- C. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies; 2018.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- F. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.
- G. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers; 2016.
- H. ICC-ES AC148 - Acceptance Criteria for Flexible Flashing Materials; 2017.
- I. ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing; 2015.
- J. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components; 2019.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for submittal requirements and procedures. Refer to BIDPACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide data on material characteristics.
- C. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

1.06 QUALITY ASSURANCE

- A. Single Source: Self-adhered water-resistive vapor permeable air barrier membrane components and accessories must be obtained as a single-source membrane system to ensure total system compatibility and integrity.
- B. Air Barrier Integrity: The Contractor shall ensure that the intent of constructing the building enclosure with a continuous air barrier system to control air leakage into or out of the conditioned space is achieved. The air barrier system shall have the following characteristics:
 - 1. It must be continuous, with all interfaces sealed.
 - 2. It must be structurally supported to withstand positive and negative air pressures applied to the building enclosure.
 - 3. Connection shall be made between (but not limited to) the following components:
 - a. Foundation wall and walls.
 - b. Walls and fenestration components.
 - c. Different wall systems.
 - d. Wall and roof system.
 - e. Wall and roof over unconditioned space.
 - f. Walls and slabs (for slabs separating conditioned from non-conditioned spaces)
 - g. Walls, floor and roof across construction, control and expansion joints.

- h. Walls, floors and roof to utility, pipe and duct penetrations.
- 4. Air Barrier Penetrations: All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made air-tight.
- C. Contractor Responsibilities: The Contractor shall provide coordination of the trades, and the sequence of construction to ensure continuity of the air barrier system joints, junctures and transitions between materials and assemblies of materials and products, from substructure to walls to roof. Provide quality assurance procedures, testing and verification. Facilitate inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction or by the Owner.

1.07 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

1.08 WARRANTY

- A. Provide manufacturer's standard material warranty in which manufacturer agrees to provide replacement material for the fully self-adhered water-resistive vapor permeable air barrier sheets installed in accordance with manufacturer's instructions that fail due to material defects within 20 years of the Date of Substantial Completion.

PART 2 PRODUCTS

2.01 AIR/WEATHER BARRIER (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

- A. Air/Weather Barrier Sheet, Self-Adhered:
 - 1. Air Permeance: 0.004 cubic feet per minute per square foot, maximum, under a pressure differential of 0.3 in. water (1.57psf) (0.02 L/s.m² @ 75 Pa) when tested in accordance with ASTM E2178.
 - 2. Water Vapor Permeance: 50 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure A (desiccant procedure).
 - 3. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for up to 90 days of weather exposure.
 - 4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less (Class A), and passes NFPA 285, when tested in accordance with ASTM E84.
 - 5. Water Resistance: Comply with applicable water-resistive requirements of ICC-ES AC38.
 - 6. Seam and Perimeter Tape: As recommended by sheet manufacturer.
 - 7. Manufacturers:
 - a. VaproShield, LLC; WrapShield SA - Self-Adhered: www.vaproshield.com/#sle.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 ACCESSORIES

- A. Sealants, Tapes, and Accessories Used for Sealing Water-Resistive Barrier and Adjacent Substrates: As indicated or complying with water-resistive barrier manufacturer's installation instructions.

- B. Self-Adhered Flashing (VP SAM): Flexible self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
1. Composition: Butyl rubber sheet laminated to elasticized polyethylene sheet.
 2. Thickness: 20 mil, 0.020 inch, nominal; exception from ASTM D1970/D1970M.
 3. Products:
 - a. VaproShield; VaproFlashing SA Self-Adhered: www.vaproshield.com.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- C. Liquid Applied Flashing: One part, fast curing, non-sag, elastomeric, gun grade, trowelable liquid -applied Silyl-Terminated-Poly-Ether (STPE) vapor permeable air barrier flashing.
1. Products:
 - a. VaproShield, LLC; VaproLiqui-Flash: www.vaproshield.com
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- D. Self-Adhered Foil Faced Flashing (Foil Faced SAM): Flexible composite membrane with 2 mil (0.05 mm) stainless steel sheet with an 8 mil (0.20 mm) butyl self-adhesive backing. For use as transition sheet in conjunction with liquid applied flashings.
1. Manufacturers:
 - a. VaproShield, LLC; Vapro-SS Flashing: www.vaproshield.com.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- E. Primer: For each membrane and substrate condition, designed to provide a high-tack finish suitable for membrane application and adhesion, as recommended by manufacturer in published literature based on lab testing and field experience.
- F. Fasteners: 1-3/4 inch-diameter pre-formed head caps with a center throat hole, sealing the membrane at fastener penetration designed and tested to withstand wind loads and protect against water intrusion at screw penetrations.
1. Basis of Design: VaproShield, VaproCaps: www.vaproshield.com.
- G. Tape (Butyl-based SAM): Black, butyl, UV-stable, single-sided, moisture-resistant flexible tape with adhesive backing for use at interfaces and laps as recommended by manufacturer.
1. Basis of Design: VaproShield, VaproTape: www.vaproshield.com.
 2. Dimensions: As recommended by manufacturer for intended use.
- H. Building Envelope Sealant: Single-component, gun-grade, silicone sealant designed to adhere to low surface-energy materials for use at laps and interfaces as recommended by manufacturer.
1. Basis of Design: VaproShield, VaproBond: www.vaproshield.com.
- I. Flexible Silicone Transition Strips: Flexible, pre-cured, unsupported, 80 mil (2 mm) extruded silicone transition strip material for use at interfaces with water and air barrier as recommended by manufacturer. Manufacturer recommended sealant shall be used in conjunction with transition strip.
1. Basis of Design: VaproShield, VaproSilicone Transition: www.vaproshield.com.

2. Dimensions: As recommended by manufacturer for intended use
- J. Termination Bar: 1 inch (25 mm) wide x 8 feet (2.4 m) long, UV-resistance rigid thermoplastic extrusion for use as recommended by manufacturer with their system, if required by sequence of installation.
 1. Basis of Design: VaproTermination Bar: www.vaproshield.com.
- K. Thinners and Cleaners: As recommended by water-resistive barrier manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and conditions comply with requirements of this section.

3.02 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

3.03 INSTALLATION

- A. Install materials in accordance with manufacturer's installation instructions.
- B. Air/Weather Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.
- D. Self-Adhesive Air/Weather Barrier Membrane Sheets:
 1. Prepare and prime substrate in manner recommended by sheet manufacturer; fill and tape joints in substrate and between dissimilar materials.
 2. Cut sheets to manageable lengths, position membrane for alignment, remove protective poly-film and firmly apply pressure to assure adhesion.
 3. Lap sheets shingle-fashion to shed water and seal laps air tight. Install in a consecutive weatherboard method starting at bottom or base of wall and working up.
 - a. Provide minimum of 2" (5 cm) side laps and 3" (7.6 cm) end laps.
 4. Once sheets are in place, press firmly into substrate with resilient hand roller using adequate pressure [+5 lbs] to ensure full contact and adhesion. Ensure that all laps are firmly adhered with no gaps or fishmouths. Seal laps air tight.
 5. Use same material, or other material approved by sheet manufacturer, to seal sheets to adjacent substrates, and as flashing.
 6. At expansion joints, provide transition to joint assemblies approved by sheet manufacturer.
 7. Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, duct work, electrical and other apparatus extending through the air/water barrier membrane and around the perimeter edge of membrane terminations at window and door frames with sealant.

- E. Fastener Penetrations Through Air/Water Barrier Membranes
1. Screws should be self-tapping; the head must be larger in diameter than the shank. In addition, the point or self-drilling portion must be no larger in diameter than the shank.
 2. All fasteners should be driven perpendicularly to the substrate until flush with the air/water barrier membrane. The fastener head should be compressed firmly against the air/water barrier membrane to create a gasketing seal without damaging the membrane.
 3. Do not install fasteners through air/water barrier membranes over unsupported areas of the substrate, like sheathing joints.
 4. Overdriven fasteners, improperly installed fasteners, defective or broken fasteners or fasteners not properly fastened into the building structure beyond the air/water barrier membrane should be removed and the vacated hole sealed with an approved sealant prior to the installation of the cladding or veneer system.

3.04 FIELD QUALITY CONTROL

- A. []'s Inspection and Testing: Cooperate with Owner's testing agency.
1. Allow access to work areas and staging.
 2. Notify []'s testing agency in writing of schedule for work of this section to allow sufficient time for testing and inspection.
 3. Do not cover work of this section until testing and inspection is accepted.
- B. Take digital photographs of each portion of installation prior to covering up weather barriers.
- C. It is the responsibility of the installing contractor to properly install and accept fastener installation and associated components which will interface with the air barrier membrane in order to maintain continuity in the air barrier assembly.

3.05 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 46 46**FIBER-CEMENT SIDING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Wood-fiber cement siding panels.
- B. Installation of wood furring.
- C. Trim and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Siding substrate framing, plywood sheathing, and preservative treated wood furring.
- B. Section 06 16 43 - Gypsum Board Sheathing: Siding substrate sheathing.
- C. Section 07 25 00 - Air and Weather Barriers: Water-resistive barrier under siding.
- D. Section 07 62 00 - Sheet Metal Flashing and Trim: Sheet metal trim integral with siding.
- E. Section 07 92 00 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- D. ASTM C1186 - Standard Specification for Flat Fiber Cement Sheets; 2008 (Reapproved 2016).

1.04 SUBMITTALS

- A. See Division 1 Project Administration for submittal requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Manufacturer's requirements for related materials to be installed by others.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation instructions edited to reflect project requirements, including nail patterns.
- C. Installer's qualification statement.
- D. Maintenance Instructions: Periodic inspection recommendations and maintenance procedures.

- E. Warranty: Submit copy of manufacturer's warranty, made out in Owner's name, showing that it has been registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of type specified in this section with not less than three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Deliver and store materials in manufacturer's unopened packaging, with labels intact, until ready for installation.
- C. Store materials under dry and waterproof cover, well ventilated, and elevated above grade on a flat surface.

1.07 WARRANTY

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Special Warranty: Standard form in which manufacturer agrees correct defective work (repair or replace panel system components that fail in materials or workmanship) within a five year period after Date of Substantial Completion.

1.08 WARRANTY

- A. Special Warranty: Standard form in which manufacturer agrees to repair or replace panel system components that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracking, deforming.
 - b. Deterioration of finishes and other materials beyond normal weathering.
 - 2. Warranty Period: 30 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 FIBER-CEMENT SIDING

- A. Panel Siding: Panels on vertical surfaces made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186 Type A Grade II; with machined edges, for nail attachment.
 - 1. Texture: Smooth.
 - 2. Length (Height): 96 inches, nominal.
 - 3. Width: 48 inches.
 - 4. Thickness: 5/16 inch, nominal.
 - 5. Finish: Factory applied primer. Manufacturer's standard acrylic primer.
 - 6. Warranty: 30 year limited; extends to the first owner and the first transferee.

7. Products:
 - a. James Hardie Building Products, Inc Hardie Panel HZ10: www.jameshardie.com.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 ACCESSORIES

- A. Furring Strips: Pressure treated 1x4 as detailed; and as specified in Section 06 10 00 – Rough Carpentry.
- B. Trim: Same material and texture as siding.
- C. Metal Trim:
 1. Finish: Factory Painted.
 2. Color: As selected by Architect.
 3. Vertical Profile Trim:
 - a. Type: As selected by Architect from manufacturer's standard line.
 4. Horizontal Profile Trim:
 - a. Type: As selected by Architect from manufacturer's standard line.
 5. Termination Profile Trim:
 - a. Type: As indicated on drawings.
 6. Outside Corner Trim:
 - a. Type: As selected by Architect from manufacturer's standard line.
- D. Exposed Fasteners: Stainless steel, galvanized, or corrosion resistant bugle-head screws, treated or primed to accept paint finish. Length as required to penetrate minimum 1-1/4 inch.
- E. Door and Window Head Vents: One piece, perforated, ASTM B221 (ASTM B221M), 6063 alloy, T5 temper, aluminum, with edge suitable for direct application to gypsum board and manufactured especially for soffit application, and provide continuous vent.
- F. Siding Vent: Cor-A-Vent, model SV-5 extruded polypropylene core, wrapped with Cor-A-Vent's Enhanced Insect Screen.
- G. Sealant: As specified in Section 07 92 00 - Joint Sealants

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.
- B. Verify that air and weather barrier has been installed over substrate completely and correctly.
- C. Do not begin until unacceptable conditions have been corrected.
- D. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and recommendations.
 - 1. Read warranty and comply with terms necessary to maintain warranty coverage.
 - 2. Install in accordance with conditions stated in model code evaluation report applicable to location of project.
 - 3. Use trim details as indicated on drawings.
 - 4. Touch up field cut edges before installing.
 - 5. Pre-drill nail holes if necessary to prevent breakage.
- B. Allow space for thermal movement between both ends of siding panels that butt against trim; seal joint between panel and trim with specified sealant.
- C. Install siding on furring strips to provide a continuously vented air cavity between siding and insulation over water resistive barrier.
- D. Install insect screen-wrapped cavity vent strips.
- E. Joints in Vertical Siding: Install Z-flashing in horizontal joints between successive courses of vertical siding.
- F. Do not install siding less than 6 inches from ground surface, or closer than 1 inch to roofs, patios, porches, and other surfaces where water may collect.
- G. Exterior Soffit Vents: Install in accordance with manufacturer's written instructions and at locations indicated on drawings; provide vent area as indicated on drawings.
- H. After installation, seal joints except lap joints of lap siding; seal around penetrations, and paint exposed cut edges.

3.03 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 54 00**THERMOPLASTIC MEMBRANE ROOFING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Adhered thermoplastic roofing membrane system.
- B. Insulation, flat and tapered.
- C. Vapor retarder.
- D. Cover boards.
- E. Membrane base flashings and coated sheet metal flashing items.
- F. Roofing stack boots and walkway pads.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood nailers and curbs.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim: Counterflashings and metal flashing and trim items associated with roofing.
- C. Section 07 72 00 - Roof Accessories: Roof hatches with ladders, prefabricated curbs, fall arrest system.
- D. Section 22 10 06 - Plumbing Piping Specialties: Roof drains, sumps, hoppers, and _____.

1.03 REFERENCE STANDARDS

- A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2019.
- C. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing; 2019.
- D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- E. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces; 2011 (Reapproved 2019).
- F. FM DS 1-28 - Wind Design; 2016.
- G. NRCA (RM) - The NRCA Roofing Manual; 2019.
- H. NRCA (WM) - The NRCA Waterproofing Manual; 2005.
- I. UL (DIR) - Online Certifications Directory; Current Edition.
- J. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D1079 and the National Roofing Contractor's Association NRCA Roofing Manual (2011) for definition of terms related to roofing work not otherwise defined in the section.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.06 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, and fasteners.
- C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, and coated sheet metal flashing shapes and profiles.
- D. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
- E. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Sustainable Design Documentation: Test report showing solar reflectance index of membrane.
- I. Specimen Warranty: For approval.
- J. Warranty Documentation:
 - 1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 2. Submit installer's written verification that installation complies with warranty conditions for waterproof membrane.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with at least 5 years of documented experience and approved by manufacturer.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact, unless otherwise indicated.
- B. Store materials in weather protected environment, clear of ground and moisture.

- C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- D. Protect foam insulation from direct exposure to sunlight.

1.09 FIELD CONDITIONS

- A. Do not apply roofing membrane during unsuitable weather.
- B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 90 degrees F.
- C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.10 WARRANTY

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Material Warranty: Provide membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within five years after installation.
- C. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
 - 1. Warranty Term: 20 years after date of Substantial Completion.
 - 2. For repair and replacement include costs of both material and labor in warranty.
 - 3. Exceptions are not Permitted:
 - a. Damage due to roof traffic.
 - b. Damage due to wind speed greater than 56 miles per hour but less than 110 miles per hour.
- D. Special Project Warranty: Provide watertight and weatherproof guarantee on the "Standard Roofing Guarantee" form included at end of this section, covering work of this section including roofing materials, flashing, underlayment, vapor retarder, and roofing accessories, signed by roofing Installer.
 - 1. Warranty Term: 2 years after date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Thermoplastic Polyolefin (TPO) Membrane Roofing Materials:
 - 1. Carlisle SynTec Systems; Sure-Weld TPO: www.carlisle-syntec.com/#sle.
 - 2. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Insulation:
 - 1. Carlisle SynTec; SecurShield Insulation: www.carlisle-syntec.com/#sle.

2. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

- A. Membrane Roofing Materials:
 1. TPO: Fully adhered Thermoplastic polyolefin (TPO) complying with ASTM D6878/D6878M, sheet contains reinforcing fabrics or scrims.
 - a. Thickness: 60 mil, 0.060 inch, minimum.
 2. Sheet Width:
 3. Solar Reflectance: 0.75, minimum, initial, and 0.65, minimum, 3-year, certified by Cool Roof Rating Council.
 4. Thermal Emissivity: 0.80, minimum, initial, and 0.79, minimum, 3-year, certified by Cool Roof Rating Council.
 5. Color: White.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Vapor Retarder: Material approved by roof manufacturer; compatible with roofing and insulation materials.
 1. Fire-retardant adhesive.
- D. Flexible Flashing Material: Same material as membrane.

2.03 COVER BOARDS

- A. Cover Boards: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.
 1. Thickness: 5/8 inch, Type X, fire-resistant.

2.04 INSULATION

- A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
 1. Classifications:
 - a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
 - (a) Class 1 - Faced with glass fiber reinforced cellulosic facers on both major surfaces of the core foam.
 - (b) Compressive Strength: Classes 1-2-3, Grade 2 - 20 psi (138 kPa), minimum.
 - (c) Thermal Resistance, R-value: 9.75 at 1-1/2 inches thick; Class 1, Grades 1-2-3, 8.4 (1.48), minimum, at 75 degrees F.
 2. Board Size: 48 by 96 inches.
 3. Board Thickness: 2.0 inches.
 4. Tapered Board: Slope as indicated; minimum thickness 1/2 inch; fabricate of fewest layers possible.
 5. Board Edges: Square.

2.05 ACCESSORIES

- A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

- B. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.
- C. Membrane Adhesive: As recommended by membrane manufacturer.
- D. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
- E. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.
- F. Insulation Adhesive: As recommended by insulation manufacturer.
- G. TPO Coated Sheet Metal: Non-reinforced thermoplastic polyolefin membrane factory laminated to hot-dipped galvanized steel manufactured, or approved, by roofing manufacturer for scuppers, fascia trim, roof deck drain flashing collars, and other sheet metal fabrications shown on drawings. Fascia trim assembly shall include cleats and other components, as required to comply with ANSI/SPRI/FM 4435/ES-1 Standard. Fascia trim shall include factory fabricated mitered corners.
- H. Sealants: As recommended by membrane manufacturer
- I. Termination bars: As recommended by membrane manufacturer
- J. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
 - 1. Composition: Roofing membrane manufacturer's standard.
 - 2. Size: 18 by 18 inches.
 - 3. Color: To match roofing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and reglets are in place and all penetrations are sealed.

3.02 INSTALLATION, GENERAL

- A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.
- B. Do not apply roofing membrane during cold or wet weather conditions.
- C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- F. Coordinate this work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

3.03 INSTALLATION - VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

- A. Install vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
 - 1. Extend vapor retarder under cant strips and blocking to deck edge.
 - 2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
- B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
- C. Attachment of Insulation: Embed each layer of insulation in adhesive in full contact, in accordance with roofing and insulation manufacturers' instructions.
- D. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.
- E. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- F. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
- G. Do not install more insulation than can be covered with membrane in same day.

3.04 COVER BOARD APPLICATION

- A. Place cover board over tapered insulation in accordance with manufacturer's instructions.
- B. Lay boards with edges in moderate contact without forcing. Cut boards to fit neatly to perimeter blocking and around penetrations through roof.
- C. Embed cover board in adhesive in full contact, in accordance with roofing and cover board manufacturers' instructions.

3.05 INSTALLATION - MEMBRANE

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Fully Adhered Application: Apply adhesive to substrate at rate of 1 gal/square (0.01 gal/sq ft) in accordance with manufacturer's instructions. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
- D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- E. Seam Welding:
 - 1. Seam Welding: Overlap edges and ends and seal seams by heat welding, minimum 2 inches (51 mm).
 - 2. Cover all seams with manufacturer's recommended joint covers.
 - 3. Probe all seams once welds have thoroughly cooled. (Approximately 30 minutes.)

4. Repair all deficient seams within the same day.
 5. Seal cut edges of reinforced membrane after seam probe is complete.
- F. At intersections with vertical surfaces:
1. Extend membrane a minimum of 8 inches onto vertical surfaces.
 2. Fully adhere flexible flashing over membrane and up to termination bars.
- G. At scuppers, fascia trim, roof deck drain flashing collars, and other TPO coated sheet metal fabrications shown on drawings, fasten coated sheet metal in place and seal by heat welding TPO flexible flashing material to coated sheet metal as follows:
1. Install TPO coated sheet metal with 1/2" to 1/4" (3 to 6 mm) between adjoining sections.
 2. Install 2" (50 mm) wide heat resistant tape over joints in TPO coated sheet metal.
 3. Heat weld a 6" (150 mm) wide piece of TPO flexible flashing material over the joint.
 4. Robotic welds to TPO coated sheet metal must be at least 1-1/2" (40 mm) wide. Hand welds must be at least 2" (51 mm) wide.
 5. Install fascia trim in accordance with manufacturer requirements for conformance with ANSI/SPRI/FM 4435/ES-1 Standard.
- H. Around roof penetrations, seal flanges and flashings with flexible flashing.
- I. Coordinate installation of roof drains and sumps and related flashings. Locate all field splices away from low areas and roof drains. Lap upslope sheet over downslope sheet.
- J. Install walkway pads as shown on Drawings. Space pad joints to permit drainage.
- K. Daily Seal: Install daily seal per manufacturers instructions at the end of each work day. Prevent infiltration of water at incomplete flashings, terminations, and at unfinished membrane edges.
- L. At pipe and conduit penetrations, install stack boots. Locations as required per MEP drawings.

3.06 FIELD QUALITY CONTROL

- A. Owner will provide testing services, and Contractor to provide temporary construction and materials for testing in accordance with requirements.
- B. Provide daily on-site attendance of roofing and insulation manufacturer's representative during installation of this work.

3.07 CLEANING

- A. Remove wrappings, empty containers, paper, and other debris from the roof daily. Dispose of debris in compliance with local, State, and Federal regulations.
- B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- C. Repair or replace defaced or damaged finishes caused by work of this section.

3.08 PROTECTION

- A. Protect installed roofing and flashings from construction operations.

- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 07 62 00**SHEET METAL FLASHING AND TRIM****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Formed Low-Slope Roof Fabrications: Prefinished sheet metal.
 - 1. Fabricated sheet metal items, including conductor heads, flashing receivers (reglets), flashings, counterflashings, gutters, downspouts, and _____.
- B. Formed Wall Fabrications: Preprimed sheet metal (field finished).
 - 1. Sill pans.
 - 2. Window flashings.
 - 3. Reglets and accessories.
- C. Miscellaneous Formed Fabrications: Including concealed cleats, wind clips, Galvanized steel sheet.
- D. Precast concrete splash pads.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood nailers for sheet metal work.
- B. Section 06 10 00 - Rough Carpentry: Field fabricated roof curbs.
- C. Section 07 25 00 - Adhered Air and Water Barriers: Coordination for through-wall penetrations at air and water barrier (AWB).
- D. Section 07 54 00 - Thermoplastic Membrane Roofing: Non-metallic flashings associated with single-ply thermoplastic membrane low-slope roofing system.
- E. Section 07 72 00 - Roof Accessories: roof hatches.
- F. Section 07 92 00 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- C. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- E. National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual; current edition.
- F. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Conform to SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 10 years.
- B. Conform to applicable code for size and method of rain water discharge.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Shop Drawings: Submit shop drawings for all shop fabricated items indicating material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
 - 1. Provide layouts at 1/4-inch scale and details at 3-inch scale.
- C. Samples: Submit two samples 4 x 4 inch in size illustrating prefinished sheet metal finish color.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA 1793 requirements and standard details, except as otherwise indicated.
- B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to NRCA recommendations for wind uplift forces of 82 psf at external corners and 60 psf at remainder of roof perimeter.
 - 1. Minimum gages shall be determined in accordance with NRCA recommendations for each application.
- C. Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- D. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

1.08 PROJECT CONDITIONS

- A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

PART 2 PRODUCTS**2.01 SHEET MATERIALS**

- A. Galvanized Steel: ASTM A653/A653M, sheet metal shall be hot-dipped galvanized with G90/Z275 zinc coating; minimum.034 inch thick base metal.

- B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 22-gauge, .034-inch thick base metal, shop pre-coated with PVDF coating.
 - 1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
 - 2. Color: As selected by Architect from manufacturer's standard colors.
- C. Preprimed Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage (0.0239) inch thick base metal, shop preprimed by the coil-coating process with epoxy primer.
- D. Steel for Welded Fabrications: 20 gage (0.0359-inch thick) steel, commercial quality with 0.20 percent copper, ASTM A 526 except ASTM A 527 for lock-forming. Sheet metal shall be hot-dipped galvanized with G90/Z275 zinc coating after welding and mill phosphatize for priming and painting.
 - 1. Shop prime and paint with polyvinylidene fluoride (PVF2) to match coping color and finish.

2.02 FABRICATION - GENERAL

- A. Shop-fabricate work to greatest extent possible. Comply with details shown, and with applicable requirements of SMACNA Manual. Fabricate for waterproof and weather-resistant performance with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work.
 - 1. Form sections to fit substrates, true to shape, accurate in size, square, and free from distortion or defects.
 - 2. Fabricate cleats of 20 ga. galvanized steel type sheet metal, minimum 2 inches wide, interlocking with sheet.
 - 3. Form pieces in longest possible lengths.
 - 4. Form exposed sheet metal work without oil-canning, buckling and tool marks, true to line and levels indicated.
 - 5. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- B. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- C. Fabricate all sheet metal materials, products, and accessories watertight.

2.03 WELDED COLUMN CAP FABRICATION

- A. Colum Caps: Weld all column caps into single units with same profile as substrates, complete with integral flashing flanges, drip edges, slopes and pre-drilled fastening holes, etc.
 - 1. Comply with shapes and sizes as shown on drawings and field measure for remaining dimensions.
 - 2. Grind all edges smooth before galvanizing, shop priming, and shop finishing.
 - 3. Hem exposed edges on underside 1/2 inch.
- B. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

2.04 CONDUCTOR HEAD AND DOWNSPOUT FABRICATION

- A. Conductor Head: SMACNA (ASMM), typical rectangular configuration shown in Figure C, with overflow opening.
- B. Downspouts: SMACNA (ASMM) Rectangular profile.

- C. Accessories: Profiled to suit conductor heads and downspouts.
 - 1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
 - 2. Conductor Head Supports: Brackets.
 - 3. Downspout Supports: Brackets and straps.
- D. Downspout Boots: J.R. Hoe & Sons Inc.; O-Series Offset Downspout Boot with side cleanout. ASTM A-48 Class 30 cast iron, with light gray rust inhibitive primer. Sized to fit downspout. www.downspoutboots.com.
- E. Seal metal joints.

2.05 EXTERIOR SILL PAN FLASHINGS

- A. Flashing Panes Exterior Windows: Premanufactured and prefinished flashing pans in configuration shown in drawings, with soldered seams, integral back dams, and integral side dams.

2.06 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Primer Type: Zinc chromate.
- C. Concealed Sealants: Non-curing butyl sealant.
- D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; translucent.
- E. Solder: ASTM B32, Alloy Grade - Sn50 (50/50).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
 - 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 2. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
 - 3. Verify roofing termination and base flashings are in place, sealed, and secure.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Clearances: Comply with NRCA "Guide for Clearance Between Pipes/Walls/Curbs" for all roof penetrations; coordinate with respective trades. Penetrations shall not occur within 5 feet of drainage basins, nor restrict drainage.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.

3.03 INSTALLATION

- A. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators,

sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.

1. Apply plastic cement compound between metal flashings and felt flashings.
 2. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
 3. Seal metal joints watertight.
- B. Secure conductor heads and downspouts in place with concealed fasteners.
- C. Connect downspouts to downspout boots, and grout connection watertight.

3.04 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes. Remove excess scrap on a daily basis and keep working surfaces free from debris.
- B. Touch-up areas of preprimed or prefinished sheet metal, as required or directed, with manufacturer's standard primer and paint. Follow manufacturer's instructions for application carefully.
- C. Protection: Advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration other than natural weathering at time of Substantial Completion.

END OF SECTION

SECTION 07 72 00**ROOF ACCESSORIES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Roof hatches with access ladders.
- B. Manufactured fall arrest anchors

1.02 RELATED REQUIREMENTS

- A. Section 07 54 00 - Thermoplastic Membrane Roofing: Low-slope roofing system.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

1.03 REFERENCE STANDARDS

- A. FM (AG) - FM Approval Guide; current edition.
- B. NRCA (RM) - The NRCA Roofing Manual; 2019.
- C. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Manufacturer's data on each product to be used including shape of components, materials and finishes, anchor types and locations.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.
- C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
- D. Warranty Documentation:
 - 1. Submit manufacturer warranty.
 - 2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

1.06 WARRANTY

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

PART 2 PRODUCTS**2.01 ROOF HATCHES**

- A. Flat Roof Access Hatches with Ladder Manufacturers:
 - 1. FAKRO America LLC; Flat Roof Access with DRL Hatch and LML Folding Ladder: www.fakrousa.com/#sle.
 - a. DRL 27 1/2 x 59 1/2 + LML 27 1/2x47 lifting frame.
 - 2. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
 - 1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
 - 2. Hinges: Heavy duty pintle type.
 - 3. Hold open arm with vinyl-coated handle for manual release.
 - 4. Latch: Upon closing, engage latch automatically and reset manual release.
 - 5. Manual Release: Pull handle on interior.
 - 6. Locking: Padlock hasp on interior.

2.02 FALL ARREST ANCHORS

- A. Manufacturers:
 - 1. Guardian Fall Protection 6305 S. 231st St., Kent, WA 98032, phone: (800) 466-6385, fax: (800) 670-7892; www.guardianfall.com. <<http://www.guardianfall.com/>>
 - 2. Miller Fall Protection Equipment, manufactured by Honeywell Safety Products, phone: (800) 873-5242, fax: (800) 892-4078; www.millerfallprotection.com. <<http://www.millerfallprotection.com/>>
 - 3. Pro-Bel Enterprises, Ltd. #103-350, East Kent Ave S Vancouver, BC V5X 4N6 [t] 604.687.1301, [f] 604.687.1306, [e] infovan@pro-bel.ca
- B. Fall Arrest Anchors - Low Slope: Prefabricated galvanized steel anchor post, D-ring, and base plate fastened through roof deck to roof joists/truss. Contractor to coordinate structural requirements in accordance with structural drawings.
 - 1. Style: Permanent anchor post with D-ring connection point.
 - a. 18" high post with 16" x 16" steel base plate
 - 2. Product:
 - a. Guardian Fall Protection: No. 00657.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Ensure structure to which roof anchor is to be attached, and on which work is to be performed, is free of all hazards, including, but not limited to, debris, rot, rust, sharp or abrasive edges and surfaces, and hazardous materials. Ensure substrate meets or exceeds all applicable requirements specified by this instruction manual.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements, in manner that maintains roofing system weather-tight integrity.
- B. Low-Slope Fall Arrest Anchors:
 - 1. Place anchors at selected installation locations.
 - 2. Install all fasteners until snug, and ensure anchor is fully secured to substrate. All base plate fastener holes must be used. See structural drawings for substrate details.
 - 3. All fasteners must be secured in accordance with manufacturer requirements to meet required load criteria.
 - 4. Clean anchor after installation. Remove all dirt, corrosives, and contaminants from anchor using plain water, use mild soap and water, then rinse and wipe dry. Do not use corrosive substances.
- C. Seal joints within components when required by component manufacturer.
- D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

3.04 CLEANING

- A. Clean installed work to like-new condition.

3.05 PROTECTION

- A. Protect installed products until completion of project.

- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 92 00**JOINT SEALANTS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Nonsag gunnable joint sealants.
- B. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 25 00 - Air and Weather Barriers: Sealants required in conjunction with water-resistive barriers.
- B. Section 08 80 00 - Glazing: Glazing sealants and accessories.

1.03 REFERENCE STANDARDS

- A. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2018.
- B. ASTM C834 - Standard Specification for Latex Sealants; 2017.
- C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2018.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.
- H. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
- I. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.

- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- E. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- F. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.
- G. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

1.05 QUALITY ASSURANCE

- A. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 - 1. Adhesion Testing: In accordance with ASTM C794.
 - 2. Compatibility Testing: In accordance with ASTM C1087.
 - 3. Allow sufficient time for testing to avoid delaying the work.
 - 4. Deliver sufficient samples to manufacturer for testing.
 - 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
- B. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
 - 1. Identification of testing agency.
 - 2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
 - a. Test date.
 - b. Copy of test method documents.
 - c. Age of sealant upon date of testing.
 - d. Test results, modeled after the sample form in the test method document.
 - e. Indicate use of photographic record of test.
- C. Field Adhesion Test Procedures:
 - 1. Allow sealants to fully cure as recommended by manufacturer before testing.
 - 2. Have a copy of the test method document available during tests.
 - 3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 - 4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
 - 5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.

6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
- D. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
1. Sample: At least 18 inches long.
 2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the 1-inch mark is that distance from the substrate, the test has failed.
 3. If either adhesive or cohesive failure occurs before minimum elongation, take necessary measures to correct conditions and retest; record each modification to products or installation procedures.

1.06 WARRANTY

- A. Correct defective work discovered within a five year period after Date of Substantial Completion.
- B. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Nonsag Sealants:
 1. Bostik Inc: www.bostik-us.com.
 2. Dow; _____: www.dow.com/#sle.
 3. Pecora Corporation: www.pecora.com.
 4. Sika Corporation; _____: www.usa.sika.com/#sle.
 5. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS. [].

2.02 JOINT SEALANT APPLICATIONS

- A. Scope:
 1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to:
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.

- b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
- c. Other joints indicated below.

B. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.

2.03 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

2.04 NONSAG JOINT SEALANTS

- A. Type 4 - Silicone Sealant: For installation at storefront windows.
- 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Color: To be selected by Architect from manufacturer's standard range.
 - 3. Products:
 - a. Dow Corning; 795 Silicone: www.dowcorning.com.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Type 2 and 5 - Silicone Sealant: For installation at W.R.B. laps and penetrations to complete air barrier.
- 1. Movement Capability: Plus and minus 25 percent.
 - 2. Products:
 - a. Dow Corning; 758 Silicone: www.dowcorning.com.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.05 SELF-LEVELING JOINT SEALANTS

- A. Type ____ - High Quality Latex-Based Sound Sealant: ASTM C834, Type OP an opaque sealant, and Grade 0, 32 degrees F, meets requirements for low-temperature flexibility.
- 1. Color: To be selected by architect from Manufacturer's standard color range.

2.06 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
- 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
 - 2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
 - 3. Open Cell: 40 to 50 percent larger in diameter than joint width.
 - 4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
- B. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

- C. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.
- D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
 - 1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
 - 2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
 - 3. Record each test on Preinstallation Adhesion Test Log as indicated.
 - 4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to Architect.
 - 5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in an inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Provide joint sealant installations complying with ASTM C1193.
- C. Install acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- I. Seal air and vapor barrier sheet and lap joints as follows:
 - 1. Apply continuous bead of sealant to substrate. Ensure that no gaps exist in sealant bead.
 - 2. Lap sheet over sealant and press into sealant bead to ensure proper and continuous bond between sheets.
 - 3. Smooth out folds and ripples occurring in sheet over sealant.

3.04 CURING

- A. Cure sealant in accordance with sealant manufacturer's instructions.
- B. Do not cover up sealant until proper curing has taken place.

3.05 FIELD QUALITY CONTROL

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

3.06 POST-OCCUPANCY

- A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width, i.e., at low temperature in thermal cycle. Report failures immediately and repair them.

END OF SECTION

SECTION 08 06 71**DOOR HARDWARE SCHEDULE****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Preliminary schedule of door hardware sets for swinging as indicated on drawings.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware: Requirements to comply with in coordination with this section.

1.03 REFERENCE STANDARDS

- A. BHMA A156.3 - American National Standard for Exit Devices; 2014.
- B. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks; 2014.
- C. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2017.
- D. BHMA A156.18 - American National Standard for Materials and Finishes; 2016.
- E. DHI (H&S) - Sequence and Format for the Hardware Schedule; 1996.

1.04 PROJECT INFORMATION

- A. Project Name: Skyway Resource Center.
 - 1. Location: 12610 76th Ave South, Bryn-Mawr-Skyway, WA 98178.
- B. Architect: Schemata Workshop, Inc..
 - 1. Location: 1720 12th Avenue, Seattle WA 98122.
 - 2. Phone Number: (206) 285-1589.
- C. Contractor: To Be Determined.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Comply with submittal requirements as indicated in Section 08 71 00.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Only manufacturers listed in Door Hardware Schedule or Section 08 71 00 are considered acceptable, unless noted otherwise.
- B. Obtain each type of door hardware as indicated from a single manufacturer and single supplier.
- C. Manufacturer's Abbreviations: Coordinate with manufacturers listed in Section 08 71 00.
 - 1. AR - Adams Rite.
 - 2. BOM - Bommer Industries.

3. CR - Corbin Russwin.
4. CUR - Curries.
5. GJ - Glynn Johnson.
6. HGR - Hager.
7. IVE - Ives.
8. LCN - LCN.
9. McK - McKinney.
10. MED - Medeco.
11. NGP - National Guard Products.
12. PEM - Pemko.
13. RIX - Rixson.
14. SA - Sargent.
15. SCH - Schlage.
16. VD - Von Duprin.
17. YA - Yale.

2.02 DESCRIPTION

- A. Door hardware sets provided represent the design intent, they are only a guideline and should not be considered a detailed or complete hardware schedule.
 1. Provide door hardware item(s) as required for similar purposes, even when item is not listed for a door in Door Hardware Schedule.
 2. Door hardware supplier is responsible for providing proper size and hand of door for products required in accordance with Door Hardware Schedule and as indicated on drawings.
 3. Quantities listed are for each Pair (PR) of doors, or for each Single (SGL) door, as indicated in hardware sets.
 4. Electrically Operated and/or Controlled Hardware not listed in schedule: furnish in accordance with section 08 71 00.

2.03 LOCK FUNCTION CODES

- A. Function Codes for Cylindrical Locks: Complying with BHMA A156.5.
 1. Code F76; Privacy Lock: Outside knob/lever locked by pushbutton on inside knob/lever. Rotating inside knob/lever or closing door releases/unlocks button. Emergency release in outside knob/lever.
 2. Code F84; Classroom Lock: Outside knob/lever locked/unlocked by key in outside knob/lever. Inside knob/lever always free. Deadlocking latchbolt.
- B. Function Codes for Mortise Locks: Complying with BHMA A156.13.
 1. Code F07; Storeroom/Exit Lock: Deadlocking latch bolt by inside knob or key outside. Outside knob rigid.
 2. Code F08; Front Door Lock: Latch bolt is operated by knob from either side except when outside knob is made inoperative by a stop or mechanical means other than key. Deadbolt is operated by turn inside. Key outside operates both locks.

- 3. Code F15; Hotel/Motel Lock: Deadlocking latch bolt by inside knob or key outside. Outside knob rigid. Deadbolt by turn inside or emergency key outside. Projecting deadbolt displays occupancy indicator and shuts out all keys except emergency. Rotating inside knob retracts both bolts.
- 4. Code F17; Deadlock: Deadbolt by key outside or turn inside.
- C. Function Codes for Exit Devices: Complying with BHMA A156.3.
 - 1. Code 01; Exit Device: Exit only/no trim.
 - 2. Code 04; Exit Device: Entrance by trim when latchbolt is retracted by key (pullside) or set in a retracted position by key.
 - 3. Code 09; Exit Device: Entrance by knob/lever with key (pullside) only. Unit is locked when the key is removed.

2.04 FINISHES

- A. Finishes: Complying with BHMA A156.18.
 - 1. Code 626: Satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D).
 - 2. Code 630: Satin stainless steel, with stainless steel 300 series base material (former US equivalent US32D).
 - 3. Code 652: Satin chromium plated over nickel, with steel base material (former US equivalent US26D).

PART 3 EXECUTION

3.01 DOOR HARDWARE SCHEDULE

- A. Organize listing of door hardware components within each hardware set in compliance with 10-Part scheduling sequence indicated in DHI (H&S), unless otherwise indicated.

3.02 HARDWARE SET # 01: "ENTRY DOORS"

- A. For use on Door Number(s): 101A, 101B, and 101C.
- B. Provide for each Pair (PR) door(s).

<u>UNITS</u>	<u>LOCK</u>	<u>ITEM</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
6 Each		HINGE	5BB1 4.5 X 4.5	652	IVE
2 Each	F08	FRONT DOOR LOCK	STOREFRONT		
2 Each	Code 01	Exit Device		620	IVE
2 Each		SURFACE CLOSER	4111 EDA	689	LCN
2 Each		WALL STOP	WS407CVX	630	IVE
6 Each		SILENCER	SR64	GRY	IVE

- C. Coordinate Entry Lock system with pairs of storefront system doors. Doors shall remain unlocked during business hours.

3.03 HARDWARE SET # 02: "UNISEX RESTROOM"

- A. For use on Door Number(s): 118A, 119A, and 208A.

B. Provide for each Single (SGL) door(s).

<u>UNITS</u>	<u>LOCK</u>	<u>ITEM</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
3 Each		HINGE	5BB1 4.5 X 4.5	652	IVE
1 Each	F76	PRIVACY LOCK	L9040 17A L583-363	626	SCH
1 Each		WALL STOP	REFER TO CLOTHES HOOK W/BUMPER		
3 Each		SILENCER	SR64	GRY	IVE

C. Provide Privacy Lock indicator to outside with "Occupied" or "Vacant" indication.

3.04 HARDWARE SET # 03: "MEETING & CONFERENCE ROOM"

A. For use on Door Number(s): 128B and 202A.

B. Provide for each Single (SGL) door(s).

<u>UNITS</u>	<u>LOCK</u>	<u>ITEM</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
3 Each		HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1 Each	F84	CLASSROOM LOCK		626	SCH
1 Each		SURFACE CLOSER	4111 EDA	689	LCN
1 Each		WALL STOP	WS407CVX	630	IVE
3 Each		SILENCER	SR64	GRY	IVE

C. Door may be locked or unlocked with a key, free egress at all times, self closing.

3.05 HARDWARE SET # 04: "VIDEO CONFERENCE ROOMS"

A. For use on Door Number(s): 120A, 122A, and 124A.

B. Provide for each Single (SGL) door(s).

<u>UNITS</u>	<u>LOCK</u>	<u>ITEM</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
3 Each		HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1 Each	F15	HOTEL/MOTEL LOCK		626	SCH
1 Each		SURFACE CLOSER	4111 EDA	689	LCN
1 Each		WALL STOP	WS407CVX	630	IVE
3 Each		SILENCER	SR64	GRY	IVE

C. Doors shall be opened with a key from the outside and manually locked from the inside. Provide indicator to outside with "Occupied" or "Vacant" indication.

3.06

3.07 HARDWARE SET # 05: "EXIT DOORS"

A. For use on Door Number(s): 117A and 201.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
3 Each		HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1 Each	CODE	EXIT DEVICE		630	IVE
	9				
1 Each		SURFACE CLOSER	4011	689	LCN
1 Each		KICK PLATE	8400 10 X 2 Inch LDW	630	IVE
1 Each		WALL STOP	WS407CVX	630	IVE
3 Each		SILENCER	SR64	GRY	IVE

C. Door to always allow manual push to exit (crash bar). Entry from the exterior only with key, always locked.

3.08 HARDWARE SET # 06: "OFFICE"

A. For use on Door Number(s): 102A, 106A, 107A, 108, 109, 110A, 121A, 123A, 125A, 127A, 209A, 210A.

B. Provide for each Single (SGL) door(s).

<u>UNITS</u>	<u>LOCK</u>	<u>ITEM</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
3 Each		HINGE	5BB1 4.5 X 4.5	652	IVE
1 Each	F17	MORTISE LOCK	L9056HD 17A L583-363	626	SCH
1 Each		PERMANENT CORE	OWNER SUPPLIED	626	BAS
1 Each		FLOOR STOP	FS434	604	IVE
3 Each		SILENCER	SR64	GRY	IVE

3.09 HARDWARE SET # 07: "JANITOR & IT"

A. For use on Door Number(s): 116A and 205A.

B. Provide for each Single (SGL) door(s).

<u>UNITS</u>	<u>LOCK</u>	<u>ITEM</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
3 Each		HINGE	5BB1 4.5 X 4.5	652	IVE
1 Each	F86	STOREROOM LOCK	L9080HD	626	SCH
1 Each		PERMANENT CORE	OWNER SUPPLIED	626	BAS
1 Each		OH STOP	410S	630	IVE
1 Each		SURFACE CLOSER	4011	689	LCN
1 Each		MOUNTING PLATE	4010-18	689	LCN
1 Each		KICK PLATE	8400 10" X 2" LDW	630	IVE
1 Each		SILENCER	SR64	GRY	IVE

C. Door is locked at all times, retract latchbolt with a key and then door closes and relocks.

3.10 HARDWARE SET # 08: "STORAGE"

A. For use on Door Number(s): 112A, 113, and 114A, .

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
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3 Each		HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1 Each	F07	STOREROOM	8200 4 X 16 INCH	630	IVE
1 Each		SURFACE CLOSER	4111 EDA	689	LCN
1 Each		KICK PLATE	8400 10" X 2" LDW	630	IVE
3 Each		SILENCER	SR64	GRY	IVE

- C. Doors must be opened with a key to unlock from the outside. Inside always free to open by rotating the handle. Should be able to hold in open position.

3.11 HARDWARE SET #09: "OVERHEAD COILING DOOR"

- A. For use on Door Number(s): 111A
- B. Hardware provided by door supplier. See 08 33 23 – Overhead Coiling Doors.

END OF SECTION

SECTION 08 11 13**HOLLOW METAL DOORS AND FRAMES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Thermally insulated hollow metal doors with frames.

1.02 RELATED REQUIREMENTS

- A. Section 07 21 00 - Building Insulation: Insulating foam sealant fill for exterior frames.
- B. Section 08 14 16 - Flush Wood Doors.
- C. Section 08 71 00 - Door Hardware.
- D. Section 09 91 13 - Exterior Painting: Field painting.
- E. Section 09 91 23 - Interior Painting: Field painting.

1.03 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National Standards Institute.
- B. HMMA: Hollow Metal Manufacturers Association.
- C. NAAMM: National Association of Architectural Metal Manufacturers.
- D. NFPA: National Fire Protection Association.
- E. SDI: Steel Door Institute.
- F. UL: Underwriters Laboratories.

1.04 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.
- C. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2018.
- F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.

- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- I. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- J. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.
- K. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- L. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- M. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- N. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2007.
- O. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- P. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.
- Q. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
 - 1. Show door types, core design, internal reinforcement, frame profiles, sizes, gages, frame anchorage details, fire rating locations and "S" label as applicable, hardware reinforcements, location and installation requirements for hardware, details of glazed openings, and other pertinent information.
 - 2. Show type of metal and coating or finish which is proposed. Indicate exterior doors and frames to be zinc coated by door openings; indicate "U" factor for exterior doors.
 - 3. Include schedule relating to type of door and frame to be installed at each scheduled door opening. Use same door and opening numbers as shown on the Drawings. Cross reference manufacturer's details to the detail references used on the Contract Drawings.
- D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

- A. General: Provide doors and frames complying with National Association of Architectural Metal Manufacturers (NAAMM) "Specification for Commercial Hollow Metal Doors and Frames" (HMMA 861), and ANSI 250.4 Acceptance Criteria.
- B. Frame Fabrication: Standard door frames may be used at openings where standard throat dimension equals wall dimensions scheduled, otherwise provide custom frames.

- C. Single Source: Obtain hollow metal doors and frames from a single manufacturer.
- D. Allowable Tolerances: Fabricate for installation within the following clearance tolerances, unless noted otherwise: Comply with NFPA 80 maximum clearances unless noted otherwise.
 - 1. Door and frame: 1/8-inch maximum.
 - 2. Meeting edges at pairs of doors: 1/8-inch.
 - 3. Interior doors with sills: 3/8-inch maximum to non-combustible thresholds.
 - 4. Interior doors without sills: 5/8-inch maximum measured to floor slab or substrate
 - 5. Exterior doors with sill having built-in or applied stops: 1/8-inch.
 - 6. Provide for clearances per door hardware templates and recommendations.
- E. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- F. Maintain at project site copies of reference standards relating to installation of products specified.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com.
 - 2. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
 - 3. Steelcraft, an Allegion brand: www.allegion.com/#sle.
 - 4. Technical Glass Products; SteelBuilt Window & Door Systems: www.tgpamerica.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 - 4. Door Edge Profile: Manufacturers standard for application indicated.
 - 5. Typical Door Face Sheets: Flush.

6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Exterior Doors: Thermally insulated.
 1. Door Core Material: Polystyrene, 1 lbs/cu ft minimum density.
 - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
 2. Door Thermal Resistance: R-Value of 6.0 minimum, for installed thickness of polystyrene.
 3. Door Thickness: 1-3/4 inches, nominal.
 4. Weatherstripping: Refer to Section 08 71 00.
- B. Interior Doors, Non-Fire Rated:
 1. Door Thickness: 1-3/4 inches, nominal.
- C. Hardware Reinforcement: Mortise, reinforce, drill and tap doors at factory for hardware in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115, SDI-107 and HMMA 861, except as otherwise specified. Provide reinforcing of the following minimum gages:
 1. Hinge Attachment Reinforcement: 7 gage minimum, 1-1/4 inch by 10 inches long.
 2. Lock face, flush bolts, concealed or surface-mounted closers and overhead stops: 12- gage minimum.
 3. Surface mounted panic devices and other surface mounted hardware: 14-gage minimum.
 4. Provide reinforcement for closers whether or not closers are listed in approved hardware schedule.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Exterior Door Frames: Full profile/continuously welded type.
 1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
 2. Frame Finish: Factory primed and field finished.
 3. Weatherstripping: Separate, see Section 08 71 00.
- C. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
 1. Frame Metal Thickness: 18 gauge, 0.042 inch, minimum.
 2. Frame Finish: Factory primed and field finished.

2.05 FINISHES

- A. General: Clean, treat, and prime exposed steel surfaces of doors and frames. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint as specified in Section 09 90 00. Rust inhibitive primer shall either be air-dried or baked-on type as standard with door and frame manufacturer.
- B. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.
 - 1. Do not use "silicone-modified" or "siliconized" primer; these have proven incompatible with waterborne topcoats.
- C. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Coordinate frame anchor placement with wall construction.
- C. Install door hardware as specified in Section 08 71 00.
- D. Coordinate installation of electrical connections to electrical hardware items.
- E. Touch up damaged factory finishes.

3.04 INSTALLATION TOLERANCES

- A. Frame Tolerances: Prior to installation, all frames must be checked and corrected for size, swing, squareness, alignment, twist and plumb. Permissible installation tolerances shall not exceed the following:
 - 1. Squareness: Plus or minus 1/16 inch measured on a line, 90 degrees from one jamb, at the upper corner of the frame at the other jamb.
 - 2. Alignment: Plus or minus 1/16 inch measured on jambs on a horizontal line parallel to the plane of the wall.

3. Twist: Plus or minus 1/16 inch measured at the face corners of jambs on parallel lines perpendicular to the plane of the wall.
 4. Plumb: Plus or minus 1/16 inch measured on the jamb at the floor.
- B. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- C. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.
- B. Adjust sound control doors so that seals are fully engaged when door is closed.
- C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

3.06 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 08 14 16**FLUSH WOOD DOORS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Flush wood doors; flush configuration; non-rated.

1.02 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames.
- B. Section 08 71 00 - Door Hardware.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2018).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2017, with Errata (2019).
- C. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.
- D. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2013.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Samples: Submit two samples of door veneer, 12" by 12" inch in size illustrating wood grain, stain color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special installation instructions.
- F. Specimen warranty.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.06 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary heat is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.07 WARRANTY

- A. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 - 1. Haley Brothers: www.haleybros.com.
 - 2. Marshfield DoorSystems, Inc: www.marshfielddoors.com.
 - 3. VT Industries, Inc; ____: www.vtindustries.com/#sle.
 - 4. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 DOORS

- A. Doors: See drawings for locations and additional requirements.
 - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: Flush solid core construction.
 - 1. Thickness: 1-3/4 inches, unless otherwise indicated.
 - 2. Facing: Rotary Birch veneer with factory transparent finish.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core Doors: Type particleboard core (PC), plies and faces as indicated.

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: Natural birch, HPVA Grade A, rotary cut, with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
- C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

- E. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

- A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System - 11, Polyurethane, Catalyzed.
 - b. Stain: As selected by Architect.
 - c. Sheen: Satin.

2.07 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 08 11 13.
- B. Door Hardware: See Section 08 71 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.

3.03 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Rehang or replace doors that do not swing or operate freely.
- C. Adjust closers for full closure.

3.04 SCHEDULE

- A. Refer to Door and Frame Schedule included in drawings.

END OF SECTION

SECTION 08 33 23**OVERHEAD COILING DOORS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Exterior coiling doors.
- B. Overhead coiling doors , operating hardware, non-fire-rated and exterior, manual operation at Tool Library.

1.02 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

1.03 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide general construction and component connections and details.
- C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- D. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.04 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for roller shaft counterbalance assembly. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Overhead Coiling Doors:
 - 1. Clopay Building Products; _____: www.clopaydoor.com/#sle.
 - 2. The Cookson Company; _____: www.cooksondoor.com/#sle.
 - 3. Overhead Door Company: www.overheaddoor.com.
 - 4. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 COILING DOORS

- A. Exterior Coiling Doors: Steel slat curtain.
 - 1. Capable of withstanding positive and negative wind loads of 20 psf without undue deflection or damage to components.

2. Single Thickness Slats: Flat, non-insulated, type F-265.
3. Nominal Slat Size: 2 inches wide by required length.
4. Finish: Powder Coat: PowerGuard..
5. PowderGuard Weathered Finish: Industrial textured powder coat provides a thicker, more scratch resistant coat. Applied to entire door system including slats, guides, bottom bar and head plate.
6. Manual hand chain lift operation.
7. Mounting: Surface mounted.
8. Locking Devices: Lock and latch handle on outside.

2.03 MATERIALS AND COMPONENTS

- A. Metal Curtain Construction: Interlocking slats.
 1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
 2. Curtain Bottom for Slat Curtains: Fitted with angles to provide reinforcement and positive contact in closed position.
 3. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.
 4. Steel Slats: Minimum thickness, 16 gauge, 0.06 inch; ASTM A653/A653M galvanized steel sheet.
 - a. Galvanizing: Minimum G90 coating.
- B. Guide Construction: Continuous, of profile to retain door in place, mounting brackets of same metal.
- C. Guides - Angle: ASTM A36/A36M metal angles, size minimum 3/16".
 1. PowderGuard Zinc Finish for guides, bottom bar and head plate..
- D. Hood: Fabricated from minimum 24 gauge galvanized steel sheet shaped to fit within the headplates. Intermediate hood support(s) furnished as required.
- E. Hood Enclosure and Trim: Provide with internal hood baffle weatherseal. Internally reinforced to maintain rigidity and shape.
 1. Minimum thickness; 24 gage, 0.025 inch.
- F. Lock Hardware:
 1. Latchset Lock Cylinders: Standard mortise cylinder.
 - a. Keying: Master keyed.
 2. Manual Chain Lift: Provide padlockable chain keeper on guide.

2.04 WARRANTY

- A. Manufacturer to provide 5-year warranty against defects in materials or workmanship.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that adjacent construction is suitable for door installation.
- B. Verify that door opening is plumb, header is level, and dimensions are correct.

- C. Notify Architect of any unacceptable conditions or varying dimensions.
- D. Commencement of installation indicates acceptance of substrate and door opening conditions.
- E. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Install enclosure and perimeter trim.

3.03 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch.
- C. Maximum Variation From Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet straight edge.

3.04 ADJUSTING

- A. Adjust operating assemblies for smooth operation.

3.05 CLEANING

- A. Clean installed components.
- B. Remove labels and visible markings.

END OF SECTION

SECTION 08 43 13**ALUMINUM-FRAMED STOREFRONTS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors and frames.
- C. Weatherstripping.
- D. Door hardware.
- E. Perimeter sealant.

1.02 RELATED REQUIREMENTS

- A. Section 07 25 00 - Air and Weather Barriers: Sealing framing to water-resistive barrier installed on adjacent construction.
- B. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
- C. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
- D. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- C. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- G. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- H. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

- I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
- D. Samples: Submit two samples ____by____ inches in size illustrating finished aluminum surface, glass, glazing materials.
- E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- F. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
- G. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- H. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- I. Specimen warranty.
- J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Aluminum-Framed Storefronts:
 - 1. Arcadia, Inc; _____: www.arcadiainc.com/#sle.
 - 2. Kawneer North America; _____: www.kawneer.com/#sle.
 - 3. Tubelite, Inc; _____: www.tubeliteinc.com/#sle.
 - 4. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Center-Set Style, Thermally-Broken:
 - 1. Basis of Design: Kawneer Trifab 451UT.

2.03 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING

- A. Center-Set Style:
 - 1. Basis of Design: Kawneer IR500.

2.04 BASIS OF DESIGN -- SWINGING DOORS

- A. Wide Stile, Insulating Glazing, Thermally-Broken:
 - 1. Basis of Design: Kawneer 500 Standard Entrances w/ 10" bottom rail.

2.05 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Finish: Class I natural anodized.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - 2. Finish Color: As selected by Architect from manufacturer's standard line.
 - 3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - 4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.

5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
6. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
7. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
9. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel, and heel bead of glazing compound.
10. Preparation for Window Treatments: Provide reinforced interior horizontal head rail at residential units.

B. Performance Requirements

1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Design Wind Loads: Comply with requirements of ASCE 7.
 - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.
3. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.
4. Overall U-value Including Glazing: .33 Btu/(hr sq ft deg F), maximum.

2.06 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 1. Glazing Stops: Flush.
- B. Interior Sliding Storefront Lites: Full glazed extruded aluminum frame and operable panels; manual operation; bottom rollers; integrated within storefront fixed glazing assembly per drawings.
 1. Configuration and Size: As indicated on drawings.
 2. Glazing: Clear, Monolithic, fully tempered safety glass
 3. Glazing Thickness: 1/4 inch.
 4. Stile Width: 2 inches.
 5. Frame Face Width: 1-1/2 inches.
 6. Provide deadlock keyed both sides on each operable panel.

2.07 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.
- C. Perimeter Sealant: As specified in Section 07 90 05.
- D. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- E. Glazing & Glazing Accessories: See Section 08 80 00.

2.08 HARDWARE

- A. For each door, include weatherstripping, sill sweep strip, and threshold.
- B. Other Door Hardware: See Section 08 71 00.
- C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
- E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors. Sizes/types per drawings.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Set thresholds in bed of sealant and secure.

- K. Install glass and infill panels in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.
- L. Install perimeter sealant in accordance with Section 07 90 05.
- M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

- A. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as indicated on drawings.
 - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

3.05 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Remove excess sealant by method acceptable to sealant manufacturer.

3.07 PROTECTION

- A. Protect installed products from damage during subsequent construction.

END OF SECTION

SECTION 08 51 13**ALUMINUM WINDOWS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Extruded aluminum windows with fixed sash and operating sash.
- B. Factory glazing.
- C. Operating hardware.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Rough opening framing.
- B. Section 06 10 00 - Rough Carpentry: Wood perimeter shims.
- C. Section 07 25 00 - Air and Weather Barriers: Sealing frame to water-resistive barrier installed on adjacent construction.
- D. Section 07 92 00 - Joint Sealants: Sealing joints between window frames and adjacent construction.
- E. Section 08 80 00 - Glazing.

1.03 REFERENCE STANDARDS

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for windows, doors, and skylights; 2017.
- B. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
- D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- E. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- F. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- G. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).
- H. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).
- I. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015.
- J. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights; 2019c.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Include component dimensions, information on glass and glazing, internal drainage details, and descriptions of hardware and accessories.
- C. Performance Validation: Provide specified performance validation before submitting shop drawings or starting fabrication.
- D. Shop Drawings: Indicate opening dimensions, elevations of different types, framed opening tolerances, anchorage locations, and installation requirements.
- E. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
 - 1. Evidence of AAMA Certification.
 - 2. Evidence of WDMA Certification.
 - 3. Evidence of CSA Certification.
 - 4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.
- F. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.
- G. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.
- H. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- I. Manufacturer's qualification statement.
- J. Specimen warranty.
- K. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of AAMA CW-10.
- B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F.
- B. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Basis of Design: Quaker Windows C600 series.
 - 1. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 BASIS OF DESIGN - AW PERFORMANCE CLASS WINDOWS

- A. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 having Performance Class of AW, and Performance Grade at least as high as specified design pressure.
- B. Provide products tested for compliance with AAMA/WDMA/CSA 101/I.S.2/A440 having Performance Class of AW, and Performance Grade as indicated under performance requirements.

2.03 ALUMINUM WINDOWS

- A. Aluminum Windows: Extruded aluminum frame and sash, factory fabricated, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.
 - 1. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.
 - 2. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 - 3. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
 - 4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- B. Fixed, Non-Operable Type with inset operable awning sash:
 - 1. Construction: Thermally broken.
 - 2. Glazing: Double; clear; low-e.
 - 3. Exterior Finish: Class I natural anodized.
 - 4. Interior Finish: Class I natural anodized.
 - 5. Operable outswing awning sash per drawings

2.04 PERFORMANCE REQUIREMENTS

- A. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific window type:

1. Performance Class (PC): AW.
- B. Design Pressure (DP): In accordance with applicable codes.

2.05 COMPONENTS

- A. Glazing: See Section 08 80 00.
- B. Operable Sash Weatherstripping: Wool pile; permanently resilient, profiled to achieve effective weather seal.
- C. Fasteners: Stainless steel.

2.06 MATERIALS

2.07 HARDWARE

- A. Sash lock: Lever handle with cam lock.

2.08 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41, clear anodic coating not less than 0.7 mil thick.
- B. Finish Color: As selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that wall openings and adjoining water-resistive barrier materials are ready to receive aluminum windows; see Section 07 25 00.

3.02 PRIME WINDOW INSTALLATION

- A. Install windows in accordance with manufacturer's instructions.
- B. Install window assembly in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
- C. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- D. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
- E. Install sill and sill end angles.
- F. Coordinate attachment and seal of perimeter air barrier and vapor retarder materials.
- G. Install operating hardware not pre-installed by manufacturer.
- H. Install glass and infill panels in accordance with requirements; see Section 08 80 00.

3.03 TOLERANCES

- A. Maximum Variation from Level or Plumb: 1/16 inches every 3 ft non-cumulative or 1/8 inches per 10 ft, whichever is less.

3.04 FIELD QUALITY CONTROL

3.05 ADJUSTING

- A. Adjust hardware for smooth operation and secure weathertight closure.

3.06 CLEANING

- A. Remove protective material from factory finished aluminum surfaces.
- B. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.

END OF SECTION

SECTION 08 62 23**TUBULAR SKYLIGHTS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Tubular skylights, consisting of skylight dome, reflective tube, and diffuser assembly; configuration as indicated on the drawings. Provide Unit Price.

1.02 RELATED REQUIREMENTS

- A. Section 07 54 23 - Thermoplastic-Polyolefin Roofing: Flashing-in of skylight base.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings.

1.03 REFERENCE STANDARDS

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for windows, doors, and skylights; 2017.
- B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021.
- C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- 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.

1.05 PERFORMANCE REQUIREMENTS

- A. Completed tubular device assemblies shall be capable of meeting the following performance requirements:
 - 1. Air Infiltration Test: Air infiltration will not exceed 0.30 cfm/sf aperture with a pressure delta of 1.57 psf across the tube when tested in accordance with ASTM E 283.
 - 2. Water Resistance Test: No uncontrolled water leakage at 10.5 psf pressure differential with water rate of 5 gallons/hour/sf when tested in accordance with ASTM E 547.
 - 3. Uniform Load Test:
 - a. No breakage, permanent damage to fasteners, hardware parts, or damage to make system inoperable or cause excessive permanent deflection of any section when tested at a Positive Load of 150 psf or Negative Load of 60 psf in accordance with ICC AC-16 Section A, or Negative Load of 70 psf if tested per ICC AC-16 Section B.

- b. All units shall be tested with a safety factor of (3) for positive pressure and (2) for negative pressure, acting normal to plane of roof in accordance with ASTM E 330.

1.06 QUALITY ASSURANCE

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.08 FIELD 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.

1.09 WARRANTY

- A. Skylights: Manufacturer's standard warranty for 10 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Solatube International, Inc: www.solatube.com/#sle.
- B. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 TUBULAR SKYLIGHTS

- A. Tubular Skylights: Transparent roof-mounted skylight dome and curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces.
- B. Brighten Up Series: Solatube Model 290DSe: 14 Inch (350MM) Daylighting System:
 1. Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
 - a. Outer Dome Glazing: Type DA, 0.125 inch (3.25) minimum thickness impact resistant injection molded acrylic classified as CC2 material; UV inhibiting (100 percent UV C, 100 percent UV B and 98.5 percent UV A), impact modified acrylic blend.
 - b. Raybender 3000: Variable prism optic molded into outer dome to capture low angle sunlight and limit high angle sunlight.
 - c. LightTracker Reflector: Aluminum sheet, thickness 0.015 inch (0.4 mm) with Spectralight Infinity. Positioned in dome to capture low angle sunlight.
 2. Flashing Base: One piece, seamless, leak-proof flashing functioning as a base support for dome and top of tube.
 - a. Base Material: Sheet steel, corrosion resistant, meeting ASTM A 653/A 653M or ASTM A 463/A 463M or ASTM A792/A792M, 0.028 inch (0.7mm) plus or minus .006 inch (.015 mm) thick.
 - b. Base Flat: Flat Type F6, no pitch 6 inches (152mm) high.

- c. Flashing Insulator: Type FI. Thermal isolation material for use under flashing.
 - d. Dome Edge Protection Band: Type PB, For fire rated roofs. Aluminized steel. Nominal thickness of 0.028 inches (0.7mm).
3. Roof Flashing Turret Extensions: Provide manufacturer's standard extensions for applications requiring additional length.
 4. Tube Ring: Attached to top of base section; 0.090 inch (2.3mm) nominal thickness injection molded high impact acrylic; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing.
 5. Ceiling Ring: Injection molded impact resistant acrylic. Nominal thickness is 0.110 inches (2.8mm).
 6. Dual Glazed Diffuser Assembly:
 - a. Lower glazing with integral injection molded acrylic Dress Ring classified as CC2 material. Nominal thickness is 0.110 inches (2.8mm):
 - (a) Classic Vusion Diffuser: Molded acrylic plastic classified as CC2 material (nominal thickness 0.090 inches (2.29 mm) with injection molded acrylic Diffuser Trim Ring. Type L4.
- C. Roof Assemblies: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
1. Glazing: Acrylic plastic, 1/8 inch minimum thickness.
 2. Dome Ring: Attached to top of base section; 0.090 inch nominal thickness injection molded high impact ABS; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing; weather seal of medium density pile weather stripping.
- D. Reflective Tube: ASTM B209/B209M aluminum sheet, thickness between 0.015 inch and 0.020 inch.
- E. Diffuser Assemblies: Supporting light transmitting surface at bottom termination of tube, with compression seal to minimize condensation and bug or dirt infiltration.
1. Ceiling Ring: Edge trim for ceiling opening; injection molded high impact ABS.
 2. Diffuser Trim: Edge and attachment trim for diffuser lens; injection molded high impact ABS.
 3. Lens: Prismatic lens design to maximize light output and diffusion.
 4. Lens Material: Acrylic plastic.
 5. Visible Light Transmission (VLT): 90 percent, minimum.
 6. Seal: Closed cell EPDM foam rubber.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Set roof assembly flashing in continuous bead of sealant.
- C. Seal joints exposed to weather in accordance with sealant manufacturer's written instructions.
- D. Conduct field test for water tightness; conduct water test in presence of Architect. Correct defective work and re-test until satisfactory.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 08 71 00**DOOR HARDWARE****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Hardware for wood, aluminum, and hollow metal doors.
- B. Electrically operated and controlled hardware.
- C. Thresholds.
- D. Weatherstripping and gasketing.

1.02 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames.
- B. Section 08 11 16 - Aluminum Doors and Frames.
- C. Section 08 14 16 - Flush Wood Doors.
- D. Section 28 10 00 - Access Control: Electronic access control devices.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. BHMA A156.1 - American National Standard for Butts and Hinges; 2016.
- C. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; 2017.
- D. BHMA A156.3 - American National Standard for Exit Devices; 2014.
- E. BHMA A156.4 - American National Standard for Door Controls - Closers; 2013.
- F. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks; 2014.
- G. BHMA A156.6 - American National Standard for Architectural Door Trim; 2015.
- H. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; 2015.
- I. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2017.
- J. BHMA A156.15 - American National Standard for Release Devices - Closer Holder, Electromagnetic and Electromechanical; 2015.
- K. BHMA A156.16 - American National Standard for Auxiliary Hardware; 2018.
- L. BHMA A156.18 - American National Standard for Materials and Finishes; 2016.
- M. BHMA A156.21 - American National Standard for Thresholds; 2014.
- N. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems Sponsor; 2017.
- O. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.

- P. BHMA A156.115W - American National Standard for Hardware Preparation in Wood Doors with Wood or Steel Frames; 2006.
- Q. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- R. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- S. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2019.
- T. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- U. UL (DIR) - Online Certifications Directory; Current Edition.
- V. UL 437 - Standard for Key Locks; Current Edition, Including All Revisions.
- W. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
- B. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:
 - 1. Architect.
 - 2. Installer's Architectural Hardware Consultant (AHC).
 - 3. Hardware Installer.
 - 4. Owner's Security Consultant.
- C. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- D. Keying Requirements Meeting:
 - 1. Attendance Required:
 - a. Contractor.
 - b. Owner.
 - c. Architect.
 - d. Installer's Architectural Hardware Consultant (AHC).
 - 2. Agenda:
 - a. Establish keying requirements.
 - 3. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
 - 4. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.
 - 5. Deliver established keying requirements to manufacturers.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
- C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
 - 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
 - 2. Provide complete description for each door listed.
- D. Shop Drawings - Electrified Door Hardware: Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
 - 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
 - 2. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
 - 3. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.
- E. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- F. Keying Schedule:
 - 1. Submit PDF copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.
- G. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Lock Cylinders: Ten for each master keyed group.
 - 3. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.07 WARRANTY

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Manufacturer's Warranty: Provide warranty against defects in material and workmanship for period indicated. Complete forms in Owner's name and register with manufacturer.

1. Closers: Five years, minimum.
2. Exit Devices: Three years, minimum.
3. Locksets and Cylinders: Three years, minimum.
4. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

- A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B. Provide individual items of single type, of same model, and by same manufacturer.
- C. Provide door hardware products that comply with the following requirements:
 1. Applicable provisions of federal, state, and local codes.
 2. Accessibility: ADA Standards and ICC A117.1.
 3. Applicable provisions of NFPA 101.
 4. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.
- D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70. Installer's architectural hardware consultant shall coordinate and specify.
 1. See Section 28 10 00 for additional access control system requirements.

2.02 HINGES

- A. Hinges: Comply with BHMA A156.1, Grade 1.
 1. Provide hinges on every swinging door.
 2. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
 3. Provide non-removable pins on exterior outswinging doors.
 4. Provide following quantity of butt hinges for each door:
 - a. Doors up to 60 inches High: Two hinges.
 - b. Doors From 60 inches High up to 90 inches High: Three hinges.

2.03 FLUSH BOLTS

- A. Flush Bolts: Comply with BHMA A156.16, Grade 1.
 1. Flush Bolt Throw: 3/4 inch, minimum.
 2. Provide dustproof floor strike for bolt into floor, except at metal thresholds.
 3. Manual Flush Bolts: Provide lever extensions for top bolt at over-sized doors.
 4. Automatic Flush Bolts: Automatically latch upon closing of door; automatic retraction of bolts when active leaf is opened; located on inactive leaf of pair of doors.

2.04 EXIT DEVICES

- A. Exit Devices: Comply with BHMA A156.3, Grade 1.
 - 1. Lever design to match lockset trim.
 - 2. Provide cylinder with cylinder dogging or locking trim.
 - 3. Provide exit devices properly sized for door width and height.
 - 4. Provide strike as recommended by manufacturer for application indicated.
 - 5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.05 LOCK CYLINDERS

- A. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
 - 1. Provide cylinders from same manufacturer as locking device.
 - 2. Provide cams and/or tailpieces as required for locking devices.

2.06 CYLINDRICAL LOCKS

- A. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 1, 4000 Series.
 - 1. Bored Hole: 2-1/8 inch diameter.
 - 2. Latchbolt Throw: 1/2 inch, minimum.
 - 3. Backset: 2-3/4 inch unless otherwise indicated.
 - 4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
 - a. Finish: To match lock or latch.

2.07 MORTISE LOCKS

- A. Mortise Locks: Comply with BHMA A156.13, Grade 1, Security, 1000 Series.
 - 1. Latchbolt Throw: 3/4 inch, minimum.
 - 2. Deadbolt Throw: 1 inch, minimum.
 - 3. Backset: 2-3/4 inch unless otherwise indicated.
 - 4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
 - a. Finish: To match lock or latch.

2.08 DOOR PULLS AND PUSH PLATES

- A. Door Pulls and Push Plates: Comply with BHMA A156.6.
 - 1. Pull Type: Straight, unless otherwise indicated.
 - 2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
 - a. Edges: Beveled, unless otherwise indicated.
 - 3. Material: Stainless steel, unless otherwise indicated.

2.09 CLOSERS

- A. Closers: Comply with BHMA A156.4, Grade 1.

1. Type: Concealed, overhead mounted.
2. Provide door closer on each exterior door.
3. Provide door closer on each fire-rated and smoke-rated door.
4. At corridor entry doors, mount closer on room side of door.
5. At outswinging exterior doors, mount closer on interior side of door.

2.10 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders (Door Checks): Comply with BHMA A156.8, Grade 1.
1. Provide stop for every swinging door, unless otherwise indicated.

2.11 PROTECTION PLATES

- A. Protection Plates: Comply with BHMA A156.6.
- B. Metal Properties: Stainless steel.
1. Metal, Heavy Duty: Thickness 0.062 inch, minimum.
- C. Edges: Beveled, on four sides unless otherwise indicated.
- D. Fasteners: Countersunk screw fasteners.

2.12 KICK PLATES

- A. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
1. Size: 8 inch high by 2 inch less door width (LDW) on push side of door.

2.13 FLOOR STOPS

- A. Floor Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
1. Provide floor stops when wall surface is not available; be cautious not to create a tripping hazard.
 2. Type: Manual hold-open, with bumper floor stop.
 3. Material: Stainless steel housing with rubber insert.

2.14 WALL STOPS

- A. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
1. Provide wall stops to prevent damage to wall surface upon opening door.
 2. Type: Bumper, concave, wall stop.
 3. Material: Stainless steel housing with rubber insert.

2.15 THRESHOLDS

- A. Manufacturers:
1. Exterior Threshold Basis of Design: Endura, ADAptive Sill System..
 2. Interior Threshold
 - a. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.

- b. Hager Companies: www.hagerco.com/#sle.
 - c. National Guard Products, Inc: www.ngpinc.com/#sle.
- B. Thresholds: Comply with BHMA A156.21.
- 1. Provide threshold at interior doors for transition between two different floor types, and over building expansion joints, unless otherwise indicated.
 - 2. Provide threshold at each exterior door, unless otherwise indicated.
 - 3. Type: Flat surface.
 - 4. Material: Aluminum.
 - 5. Threshold Surface: Fluted horizontal grooves across full width.
 - 6. Field cut threshold to profile of frame and width of door sill for tight fit.
 - 7. Provide non-corroding fasteners at exterior locations.

2.16 WEATHERSTRIPPING AND GASKETING

- A. Weatherstripping and Gasketing: Comply with BHMA A156.22.
- 1. Head and Jamb Type: Adjustable.
 - 2. Door Sweep Type: Door shoe with drip cap.
 - 3. Material: Aluminum, with neoprene weatherstripping.

2.17 COAT HOOKS

- A. Coat Hooks: Provide on room side of door, screw fastened.
- 1. Material: Stainless steel.

2.18 SILENCERS

- A. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
- 1. Single Door: Provide three on strike jamb of frame.
 - 2. Pair of Doors: Provide two on head of frame, one for each door at latch side.
 - 3. Material: Rubber, gray color.

2.19 FIRE DEPARTMENT LOCK BOX (KNOX BOX)

- A. Fire Department Lock Box: Coordinate location on building with Architect and local Fire Marshal.
- 1. Heavy-duty, recessed, solid stainless-steel box with hinged door and interior gasket seal; single drill resistant lock with dust covers.
 - 2. Capacity: Holds 10 keys.
 - 3. Finish: Manufacturer's standard black.

2.20 FINISHES

- A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
- 1. Primary Finish: 630; satin stainless steel, with stainless steel 3000 series base material (former US equivalent US32D); BHMA A156.18.
 - 2. Secondary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.

- a. Use secondary finish in kitchens, bathrooms, and other spaces containing chrome or stainless steel finished appliances, fittings, and equipment; provide primary finish on one side of door and secondary finish on other side if necessary.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Use templates provided by hardware item manufacturer.
- C. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
 1. Mounting heights in compliance with ADA Standards:
 - a. Locksets: 40-5/16 inch.
 - b. Push Plates/Pull Bars: 42 inch.
 - c. Deadlocks (Deadbolts): 48 inch.
 - d. Exit Devices: 40-5/16 inch.
 - e. Door Viewer: 43 inch; standard height 60 inch.
- D. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Section 01 40 00 - Quality Requirements.

3.04 ADJUSTING

- A. Adjust work under provisions of Section 01 70 00 - Execution and Closeout Requirements.
- B. Adjust hardware for smooth operation.
- C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.05 CLEANING

- A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.06 PROTECTION

- A. Do not permit adjacent work to damage hardware or finish.

END OF SECTION

SECTION 08 80 00**GLAZING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Insulating glass units.
- B. Glazing units.
- C. Plastic sheet glazing units.
- D. Plastic films.
- E. Laminate
- F. Glazing compounds.

1.02 RELATED REQUIREMENTS

- A. Section 07 25 00 - Air and Weather Barriers.
- B. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.
- C. Section 08 43 13 - Aluminum-Framed Entrances and Storefronts: Glazing furnished as part of storefront assembly.
- D. Section 08 51 13 - Aluminum Windows: Glazing provided by window manufacturer
- E. Section 10 28 00 - Toilet, Bath, and Utility Room Accessories: Mirrors.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- E. ASTM C1036 - Standard Specification for Flat Glass; 2016.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- I. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015.
- J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- K. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- L. GANA (GM) - GANA Glazing Manual; 2008.

- M. GANA (SM) - GANA Sealant Manual; 2008.
- N. GANA (LGRM) - Laminated Glazing Reference Manual; 2009.
- O. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2017.
- P. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014, with Errata (2017).
- Q. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2017.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data on All Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Samples: Submit two samples 12 by 12 inch in size of glass units, showing coloration and design.
- E. Certificate: Certify that products of this section meet or exceed specified requirements.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- 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. Extra Insulating Glass Units: One of each glass size and each glass type.

1.06 PERFORMANCE REQUIREMENTS

- A. Provide glass and glazing materials for continuity of building enclosure weather barrier. Maintain continuous weather barrier throughout the glazed assembly from glass pane to heel bead of glazing sealant. Coordinate with requirements of Section 07 92 05 - Interior Joint Sealants.
 - 1. In conjunction with weather barrier and joint sealer materials described in other sections.
- B. Select type and thickness of exterior glass to withstand dead loads and wind loads acting normal to plane of glass at design pressures calculated in accordance with Seattle Building Code.
 - 1. Use the procedure specified in ASTM E 1300 to determine glass type and thickness.
 - 2. For glass supported of all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 3/4", whichever is less.

3. Thicknesses listed are minimum.
4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
5. Safety Glazing: Provide safety glazing where indicated and where required by applicable code, even if not indicated on drawings or within the specification.

1.07 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience.

1.08 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.09 WARRANTY

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Insulating Glass Units: Provide a twenty (20) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.
- C. Laminated Glass: Provide a twenty (20) year manufacturer warranty to include coverage for delamination, including replacement of failed units.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
 1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
 3. Glass thicknesses listed are minimum.
- B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
 1. In conjunction with weather barrier related materials described in other sections, as follows:
 - a. Air and Water-Resistive Barriers: See Section [].

- C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 3. Solar Optical Properties: Comply with NFRC 300 test method.

2.02 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
 2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
 3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
 4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
- B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.

2.03 SEALED INSULATING GLASS UNITS

- A. Sealed Insulating Glass Units: Types as indicated.
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
 3. Metal-Edge Spacers: Aluminum, bent and soldered corners.
 4. Spacer Color: Aluminum.
 5. Edge Seal:
 - a. Single-Sealed System: Provide silicone sealant as secondary seal applied glass to elastomer around perimeter.
 6. Color: Gray.
 7. Purge interpane space with dry air, hermetically sealed.
- B. Type IG-1 - Sealed Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
 2. Space between lites filled with argon.
 3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (passive type), on #2 surface.
 4. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.

- a. Tint: Clear.
 5. Total Thickness: 1 inch.
 6. Thermal Transmittance (U-Value): Refer to Window Schedule, in drawings.
 7. Visible Light Transmittance (VLT): Refer to Window Schedule , in drawings.
 8. Solar Heat Gain Coefficient (SHGC): Refer to Window Schedule , in drawings.
- C. Type IG-2 - Sealed Insulating Glass Units: Safety glazing.
1. Applications:
 - a. Glazed lites in exterior doors.
 - b. Glazed sidelights and panels next to exterior doors.
 - c. Glazed lites in exterior windows and storefront, where noted on drawings.
 - d. Other locations required by applicable federal, state, and local codes and regulations.
 - e. Other locations indicated on drawings.
 2. Space between lites filled with air.
 3. Glass Type: Same as other vision glazing except use fully tempered float glass for both outboard and inboard lites.
 4. Tint: Clear.
 5. Total Thickness: 1 inch.
 6. Thermal Transmittance (U-Value): Refer to Window Schedule, in drawings.

2.04 GLAZING UNITS

- A. Type G-1 - Monolithic Interior Vision Glazing:
1. Applications: Interior Glazing unless otherwise specified.
 2. Glass Type: Annealed float glass.
 3. Tint: Clear.
 4. Thickness: 1/4 inch, nominal.
- B. Type G-2 - Monolithic Interior Vision Glazing - Translucent:
1. Applications: As indicated in drawings.
 2. Glass Type: Annealed float glass - frosted.
 3. Tint: Clear.
 4. Thickness: 1/4 inch, nominal.
- C. Type G-3 - Monolithic Interior Glazing - Opaque:
1. Applications: As indicated in drawings.
 2. Glass Type: Annealed float glass - frosted.
 3. Coating: Back-painted on concealed surface and highly opaque.
 4. Tint: Clear.
 5. Thickness: 1/4 inch, nominal.
- D. Type G-4 - Monolithic Safety Glazing: Non-fire-rated.

1. Applications:
 - a. Glazed lites in doors, except fire doors.
 - b. Glazed sidelights to doors, except in fire-rated walls and partitions.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 - d. Other locations indicated on drawings.
 2. Glass Type: Fully tempered safety glass as specified.
 3. Tint: Clear.
 4. Thickness: 1/4 inch, nominal.
- E. Type G-5 - Monolithic Safety Glazing - Translucent: Non-fire-rated.
1. Applications:
 - a. As Indicated in drawings.
 2. Glass Type: Fully tempered safety glass as specified - frosted.
 3. Tint: Clear.
 4. Thickness: 1/4 inch, nominal.
- F. Type M-1 - Transparent One-Way Mirror: Mirror quality float glass with pyrolytic (hard coat) type coating located on high light level surface of glass; ASTM C1376.
1. Applications: Locations as indicated on drawings.
 2. Thickness: 1/4 inch.
 3. Glass Tint: Grey.
 4. Glass Type: Fully tempered.
 5. Glazing Method: Interior dry method, tape and tape.

2.05 PLASTIC SHEET GLAZING UNITS

- A. Type P-1 - Polycarbonate Flat Sheet: Ultraviolet (UV) stabilized.
1. Applications: Locations as indicated on drawings.
 2. Silicone abrasion resistant coating for scratch resistance.
 3. Tint: White Diffuser.
 4. Thickness: 0.50 inch.
 5. Width: 48 inch.
 6. Manufacturers:
 - a. Palram; PALSUN, Type Basic: www.palram.com/#sle.

2.06 PLASTIC FILMS

- A. Type F-2 - Safety and Security Plastic Film: Polyester type meeting the requirements of CPSC 16 CFR part 1201. Comply with the test criteria for Category II.
1. Application: On existing double-height, south lobby glazing that is to remain..
 2. Color: Clear.
 3. Film Thickness: Single-ply; 7 mill (0.18mm)
 4. Visible Light Transmittance (VLT): 87 percent, nominal.

5. Solar Heat Gain Coefficient: 0.79
6. U-Value: 1.02
7. UV Rejection: 99 percent
8. Manufacturers:
 - a. 3M Safety & Security Window Film; Safety S70;
https://www.3m.com/3M/en_US/p/d/b5005059013/.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.07 GLAZING COMPOUNDS

- A. Butyl Sealant: Single component; ASTM C920, Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; color as selected.
- B. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.
- C. Sealant at Polycarbonate Glazing: Single component elastomeric silicone which complies with FSTT-S-001543, Class A, nonsag, ASTM C-920 Type S, Grade NS Class 25. Use G for high modulus silicone. Dow Corning 795 ,GE Silpruf SC2000 or Tremco ProGlaze SSG.

2.08 ACCESSORIES

- A. Setting Blocks: Neoprene, with 80 to 90 Shore A durometer hardness. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
 1. Width: 1/2 inch.
 2. Thickness: 1/8 inch.
 3. Manufacturers:
 - a. Tremco Global Sealants; 440: www.tremcosealants.com/#sle.
- D. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry immediately before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.
- D. Window Film: Remove existing films and graphics from the windows. Clean and prepare for new film per product manufacturer requirements.

3.03 INSTALLATION, GENERAL

- A. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- B. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE); FOR POLYCARBONATE GLAZING

- A. Application - Interior Glazed: Set glazing infills from the interior of the building.
- B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
- E. Place glazing tape on free perimeter of glazing in same manner described above.
- F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- G. Carefully trim protruding tape with knife.

3.05 FIELD QUALITY CONTROL

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

3.06 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove nonpermanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.07 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 09 05 61**COMMON WORK RESULTS FOR FLOORING PREPARATION****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - 1. Resilient sheet.
 - 2. Carpet tile.
- B. Preparation of new and existing concrete floor slabs for installation of floor coverings.
- C. Preparation of new wood-based floors and subfloors for installation of new floor coverings.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete admixture for slabs to receive adhered flooring, to prevent moisture content-related flooring failures.

1.03 REFERENCE STANDARDS

- A. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 2020.
- B. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- C. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Copies of specified test methods.
 - 4. Recommendations for remediation of unsatisfactory surfaces.
 - 5. Submit report to Architect.
 - 6. Submit report not more than two business days after conclusion of testing.

- D. Adhesive Bond and Compatibility Test Report.

1.06 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.
 - 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

- A. Perform following operations in the order indicated:
 - 1. Preliminary cleaning.
 - 2. Specified remediation, if required.
 - 3. Patching, smoothing, and leveling, as required.
 - 4. Other preparation specified.
 - 5. Adhesive bond and compatibility test.
 - 6. Protection.

3.02 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.03 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- D. Do not fill expansion joints, isolation joints, or other moving joints.

3.04 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.05 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 21 16**GYPSUM BOARD ASSEMBLIES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Performance criteria for gypsum board assemblies.
- B. Metal channel ceiling framing.
- C. Resilient sound isolation clips.
- D. Gypsum wallboard.
- E. Joint treatment and accessories.
- F. Noise barriers in gypsum board assemblies.

1.02 RELATED REQUIREMENTS

- A. Section 07 21 00 - Thermal Insulation: Thermal and acoustic insulation.
- B. Section 07 25 00 - Air and Weather Barriers: Water-resistive barrier over sheathing.
- C. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- D. Section 09 30 00 - Tiling: Tile backing board.

1.03 REFERENCE STANDARDS

- A. AISI S220 - North American Standard for Cold-Formed Steel Framing - Nonstructural Members; 2015.
- B. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.
- D. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2019b.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2018.
- G. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2019.
- H. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- I. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- J. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data:
 - 1. Provide data on gypsum board, accessories, and joint finishing system.
- C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- D. Test Reports: For stud framing products that do not comply with AISI S220 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.
- E. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 3 years of experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.

2.02 METAL FRAMING MATERIALS

- A. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
 - 1. Ceiling Channels: C-shaped.
 - 2. Resilient Sound Isolation Clips: Steel resilient clips with molded rubber isolators, attaches to framing; improves noise isolation performance of wall and floor-ceiling assemblies.
 - 3. Noise Barriers: Mass loaded vinyl interlayer in acoustical gypsum board assemblies as indicated on drawings.
 - a. Roll Width: 54 inches.
 - b. Roll Length: 30 feet.

2.03 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. CertainTeed Corporation: www.certainteed.com.
 - 2. Georgia-Pacific Gypsum: www.gpgypsum.com.
 - 3. USG Corporation: www.usg.com.
 - 4. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.

1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
4. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 5/8 inch.
 - c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
5. Gypsum Wallboard for Wet Areas: Glass Mat Faced Products:
 - a. National Gypsum Company; Gold Bond eXP Interior Extreme Gypsum Panel:
www.nationalgypsum.com/#sle.
 - b. USG Corporation; Sheetrock Brand Glass-Mat Panels Mold Tough Regular 1/2 in. (12.7 mm):
www.usg.com/#sle.
 - c. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.04 GYPSUM BOARD ACCESSORIES

- A. Acoustic Insulation: See Section 07 21 00.
- B. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel, unless noted otherwise.
 1. Corner Beads: Low profile, for 90 degree outside corners.
 2. Expansion Joints:
 - a. Type: V-shaped metal with factory-installed protective tape.
- C. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
- D. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

- A. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
 1. Level ceiling system to a tolerance of 1/1200.
- B. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

- C. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.
- D. Blocking: Install wood blocking for support of:
 - 1. Framed openings.
 - 2. Wall-mounted cabinets.
 - 3. Plumbing fixtures.
 - 4. Toilet accessories.

3.03 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
- B. Corner Beads: Install at external corners, using longest practical lengths.

3.05 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
 - 2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
 - 3. Taping, filling, and sanding are not required at base layer of double-layer applications.

3.06 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 30 00**TILING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Coated glass mat backer board as tile substrate.
- D. Ceramic trim.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Tile backer board.

1.03 REFERENCE STANDARDS

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2017.
- B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 2017.
- C. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement; 1999 (Reaffirmed 2016).
- D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).
- F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2010).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2010).
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017.
- K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
- L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).

- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2016).
- N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2017.
- O. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Vertical and Overhead Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Improved Modified Dry-Set Cement Mortar; 2020.
- P. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2019.
- Q. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018.
- R. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- S. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2019, with Editorial Revision (2020).
- T. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2016a.
- U. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- V. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, and setting details.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Installer's Qualification Statement:
 - 1. Submit documentation of National Tile Contractors Association (NTCA) or Tile Contractors' Association of America (TCAA) accreditation.

2. Submit documentation of completion of apprenticeship and certification programs.
- G. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- 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.
 2. Extra Tile: 10 square feet of each size, color, and surface finish combination.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Installer Certification:
 - a. Advanced Certifications for Tile Installers (ACT): Certification in the installation of membranes, mortar bed (mud) floors, mortar (mud) walls, shower receptors, large format tile, gauged porcelain tile/panels/slabs, and grouts.

1.07 MOCK-UPS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
 1. Minimum size of mock-up is indicated on drawings.
 2. Approved mock-up may remain as part of work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE

- A. Manufacturers: All products by the same manufacturer.
 1. Dal-Tile Corporation; Classic: www.daltile.com/#sle.
 2. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Porcelain Tile: ANSI A137.1, standard grade.
 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 2. Size: 3 x 6 inch, nominal.
 3. Thickness: 3/8 inch.

4. Surface Finish: Matte glazed.
5. Color(s): Cornsilk.
6. Pattern: Stacked.
7. Trim Units: Matching bullnose, cove base, and cove shapes in sizes coordinated with field tile.

2.02 TRIM AND ACCESSORIES

- A. Ceramic Trim: Matching cove base ceramic shapes in sizes coordinated with field tile.
 1. Applications:
 - a. Open Edges: Bullnose.
 - b. Inside Corners: Jointed.
 - c. Floor to Wall Joints: Cove base.
 2. Manufacturers: Same as for tile.

2.03 SETTING MATERIALS

- A. Manufacturers:
 1. ARDEX Engineered Cements: www.ardexamericas.com.
 2. LATICRETE International, Inc: www.laticrete.com/sle.
 3. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.04 GROUTS

- A. Manufacturers:
 1. ARDEX Engineered Cements: www.ardexamericas.com.
 2. LATICRETE International, Inc: www.laticrete.com/#sle.
 3. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.05 MAINTENANCE MATERIALS

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
 1. Applications: Between tile and plumbing fixtures.
 2. Color(s): As selected by Architect from manufacturer's full line.

2.06 ACCESSORY MATERIALS

- A. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
- B. Mesh Tape: 2 inch wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
 - 1. Test as Follows:
 - a. Alkalinity (pH): ASTM F710.
 - b. Internal Relative Humidity: ASTM F2170.
 - c. Moisture Vapor Emission: ASTM F1869.
 - 2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

3.03 INSTALLATION - GENERAL

- A. Install tile and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Tile pattern as indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles square.
- F. Sound tile after setting. Replace hollow sounding units.
- G. Keep control and expansion joints free of mortar, grout, and adhesive.
- H. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

- J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
- L. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 INSTALLATION - WALL TILE

- A. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.

3.05 CLEANING

- A. Clean tile and grout surfaces.

END OF SECTION

SECTION 09 51 00**ACOUSTICAL CEILINGS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Suspended metal grid ceiling system.

1.02 RELATED REQUIREMENTS

- A. Section 09 51 53 - Direct-Applied Acoustical Ceilings.
- B. Section 26 51 00 - Lighting: Light fixtures in ceiling system.
- C. Section 28 46 00 - Fire Detection and Alarm: Fire alarm components in ceiling system.

1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.
- C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2020.
- E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2019.
- F. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Evaluation Service Reports: Show compliance with specified requirements.
- E. Samples: Submit two samples 6 by 6 inch in size illustrating material and finish of acoustical units.

- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.06 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category D, E, or F and complying with the following:
 - 1. Local authorities having jurisdiction.

2.02 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
- B. Acoustical Tiles: Painted mineral fiber, with the following characteristics:
 - 1. Classification: ASTM E1264 Type III.
 - 2. Size: 24 by 24 inches.
 - 3. Thickness: 3/4 inch.
 - 4. Tile Edge: Square.
 - a. Joint: Kerfed and rabbeted.
 - 5. Suspension System: Exposed grid.
 - 6. Suspension System: Concealed.
 - 7. Products:
 - a. Armstrong World Industries, Inc; Fine Fissured: www.armstrongceilings.com/#sle.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.03 SUSPENSION SYSTEM(S)

- A. Exposed Suspension System: Hot-dipped galvanized steel grid with steel cap.
 - 1. Application(s): Seismic.
 - 2. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 - 3. Profile: Tee; 15/16 inch face width.
 - 4. Finish: Baked enamel.
 - 5. Color: White.
 - 6. Products:
 - a. Certaineed Architectural; 15/16" EZ Stab Classic System: www.certainteed.com/ceilings-and-walls/#sle.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.04 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
- C. Perimeter Moldings: Same metal and finish as grid.
- D. Acoustical Sealant For Perimeter Moldings: Specified in Section 07 90 05.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected plan.
- D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
- E. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch clearance between grid ends and wall.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.

- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.

3.05 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 51 53**DIRECT-APPLIED ACOUSTICAL CEILINGS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Acoustic units.
- B. Perimeter trim.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 90 05 - Joint Sealers.

1.03 REFERENCE STANDARDS

- A. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustic ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Install acoustic units after interior wet work is dry.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide data on acoustic units.
- C. Shop Drawings: Indicate tile layout and related junctions with other work or ceiling finishes, interrelation of mechanical and electrical items related to system.
- D. Samples: Submit two samples, 6 by 6 inch in size, illustrating material and finish of acoustic units.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.07 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after installation.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Direct Applied Acoustical Ceilings:

1. Armstrong World Industries, Inc: www.armstrong.com/#sle.
2. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 MATERIALS

- A. Acoustic Tile: Mineral fiber, ASTM E1264 Type _____.
 1. Size: 12 by 12 inches.
 2. Thickness: 3/4 inches.
 3. Light Reflectance: <85% percent.
 4. Edge: Square.
 5. Surface Color: White.
 6. Surface Finish: Non-directional fissured .
- B. Adhesive: Waterproof, gun grade; type recommended by tile manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION

- A. Install system in accordance with manufacturer's instructions.
- B. Locate tile on room axis according to reflected plan.
- C. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.
- D. Install acoustic units level in uniform plane.

END OF SECTION

SECTION 09 54 26**SUSPENDED WOOD CEILINGS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Wood panel ceiling grilles.
- B. Metal suspension system.

1.02 RELATED REQUIREMENTS

- A. Section 09 51 00 - Acoustical Ceilings: Metal suspension systems.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- B. CISCA (WC) - Wood Ceilings Technical Guidelines; 2009.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Shop Drawings: Indicate accessory attachments, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.
- C. Product Data: Provide data on wood ceiling components and suspension system components.
- D. Samples: Submit two full size samples illustrating material and finish of wood ceiling components.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with at least three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wood ceiling components to project site in original, unopened packages.
- B. Store in fully enclosed space, flat, level and off the floor.

1.07 FIELD CONDITIONS

- A. Do not install suspended wood ceiling system until wet construction work is complete and permanent heat and air conditioning is installed and operating.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Suspended Wood Ceilings:
 - 1. Armstrong World Industries, Inc; Woodworks: www.armstrongceilings.com/#sle.

2. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 SUSPENDED WOOD CEILING SYSTEM

- A. Performance Requirements:
 1. Design for maximum deflection of 1/360 of span.
 2. Design to resist seismic load by using practices specified in ASTM E580.
 3. Surface Burning Characteristics: Flame spread index of 200, smoke developed index of 450, when tested in accordance with ASTM E84.
- B. Wood-Based Materials:
 1. Solid Wood: Clear, dry, sound, plain sawn, selected for compatible species, grain and color, no defects.
- C. Wood Grilles: Pre-assembled module of solid wood grilles with battens.
 1. Module Size: 24 by 96 inches, nominal.
 2. Grille Size: 5/8 inch width by 2-1/4 inch depth.
 3. Grille Spacing (Reveal): 2 inch.
 4. Acoustical Backer: Recycled cotton, 1 inch thick.
 - a. Color: Black.
 5. Solid Wood Species: Poplar.
 - a. Factory Finish: custom color to match existing glulam beams in lobby..
 6. Attachment to Suspension Grid: Direct screw attachment to suspension grid.
 7. Products:
 - a. Armstrong, Woodworks Grille.
<https://www.armstrongceilings.com/commercial/en/commercial-ceilings-walls/woodworks-grille-classics-ceiling-tiles.html>
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Do not install ceiling until after interior wet work is dry.

3.02 PREPARATION

- A. Layout wood ceiling components in pattern according to reflected ceiling plan and as shown on shop drawings.
- B. Acclimate wood ceiling materials by removing from packaging in installation area a minimum of 48 hours prior to installation.

3.03 INSTALLATION

- A. General: Install suspended wood ceiling system in accordance with CISCA (WC).
- B. Wood Ceiling:
 - 1. Install wood ceilings in accordance with manufacturer's instructions.
 - 2. Fit wood components in place, free from damaged edges or other defects detrimental to appearance and function.
 - 3. Install components in uniform plane, and free from twist, warp, and dents.
 - 4. Cut to fit irregular grid and perimeter edge trim.
 - 5. Make field cut edges of same profile as factory edges, seal and finish according to manufacturer.
 - 6. Install acoustical backer above wood ceiling components; fit tight between grid members.

3.04 CLEANING

- A. Clean and touch up minor finish damage. Remove and replace components that cannot be successfully cleaned and repaired.

END OF SECTION

SECTION 09 65 00**RESILIENT FLOORING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Resilient sheet flooring.
- B. Resilient tile flooring.
- C. Resilient base.
- D. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.
- B. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
- C. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.03 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2019, with Editorial Revision (2020).
- B. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2020.
- C. ASTM F1861 - Standard Specification for Resilient Wall Base; 2016.
- D. ASTM F2034 - Standard Specification for Sheet Linoleum Floor Covering; 2018.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate seaming plans and floor patterns.
- D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- E. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.
- F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
- G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

- 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.
 - 2. Extra Flooring Material: Provide an additional 5 percent of the overall square feet required of each type and color.
 - 3. Extra Wall Base: Provide an additional 5 percent of the overall linear feet required of each type and color.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Protect roll materials from damage by storing on end.
- D. Do not double stack pallets.

1.07 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 SHEET FLOORING

- A. Linoleum Sheet Flooring: Homogeneous wear layer bonded to backing, with color and pattern through wear layer thickness.
 - 1. Manufacturers:
 - a. Forbo Marmoleum, Fresco; www.forbo.com.
 - (a) Color: 3252 Sparrow
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
 - 2. Minimum Requirements: Comply with ASTM F2034, Type corresponding to type specified.
 - 3. Backing: Jute fabric.
 - 4. Gauge (Wear Layer Thickness): 0.098 inch, minimum, excluding backing.
 - 5. Seams: Heat welded.
 - 6. Pattern: Marbleized.
 - 7. Color: To be selected by Architect from manufacturer's full range.

- B. Welding Rod: Forbo Marmoweld; Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.

2.02 TILE FLOORING

- A. Luxury Vinyl Tile: Solid vinyl with color and pattern throughout thickness.
 - 1. Manufacturers:
 - a. Interface; Product: Ridge LVT.
 - (a) Color: A02305 "Mushroom"
 - (b) Installation: Ashlar
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
 - 2. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
 - 3. VOC Content Limits: As specified in Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 4. Plank Tile Size: 4 by 36 inch.
 - 5. Wear Layer Thickness: 0.020 inch.
 - 6. Total Thickness: 0.135 inch.
 - 7. Pattern: As selected by Architect from manufacturer's full range..
 - 8. Color: To be selected by Architect from manufacturer's full range.

2.03 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
 - 1. Manufacturers:
 - a. Burke Flooring: www.burkeflooring.com/#sle.
 - b. Johnsonite, a Tarkett Company: www.johnsonite.com.
 - c. Roppe Corporation; Contours Profiled Wall Base System: www.roppe.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Height: 4 inch and 6 inch heights as indicated in Finish Schedule.
 - 3. Thickness: 0.125 inch.
 - 4. Finish: Satin.
 - 5. Length: Roll.
 - 6. Color: To be selected by Architect from manufacturer's standard range.
 - 7. Accessories: Premolded external corners and internal corners.

2.04 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
 - 1. VOC Content Limits: As specified in Section 01 61 16.
- C. Moldings, Transition and Edge Strips: Same material as flooring.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- B. Prohibit traffic until filler is fully cured.
- C. Clean substrate.
- D. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
 - 1. Fit joints and butt seams tightly.
 - 2. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - SHEET FLOORING

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Seams are prohibited in bathrooms, toilet rooms, and custodial closets.
- C. Cut sheet at seams in accordance with manufacturer's instructions.
- D. Seal seams by heat welding where indicated.

3.05 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

3.06 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.07 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 66 13**PORTLAND CEMENT TERRAZZO FLOORING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Cast-in-place terrazzo floor. Includes refinishing existing terrazzo lobby floors, as well as new infill areas.
- B. Divider strips and termination edging.
- C. Refinishing of existing terrazzo floor.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete subfloor with wood float finish.
- B. Section 05 51 00 - Metal Stairs
- C. Section 12 48 13 - Entrance Floor Mats and Frames.

1.03 REFERENCE STANDARDS

- A. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
- B. ASTM C150/C150M - Standard Specification for Portland Cement; 2020.
- C. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.
- D. NTMA (SPECS) - NTMA Terrazzo Specifications; Current Edition.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide data for divider strips, expansion joints, and sealer; include printed copy of current NTMA recommendations for the type of terrazzo specified.
- C. Shop Drawings: Indicate divider strip layout and details of adjacent components.
- D. Samples for Initial Selection: NTMA color plates showing the full range of colors and patterns available for each terrazzo type indicated.
- E. Samples: Submit two samples, 6 by 6 inch in size illustrating color, chip size and variation, chip gradation, mortar color, and typical divider strip.
- F. Cleaning and Maintenance Data: Include procedures for stain removal, stripping, and sealing.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with NTMA recommendations as posted on their web site at www.ntma.com.
- B. Installer Qualifications: Company specializing in performing the work of this section with not fewer than 5 years of documented experience.

1. Engage an experienced terrazzo grinder and finisher who has completed special concrete finish work similar in material, design and extent to that indicated for this project and with documented record of successful in-service performance.

1.06 FIELD CONDITIONS

- A. Do not install terrazzo when temperature is below 50 degrees F or above 90 degrees F.
- B. Maintain temperature within specified range 24 hours before, during, and 72 hours after installation of terrazzo.

PART 2 PRODUCTS

2.01 PORTLAND CEMENT TERRAZZO APPLICATIONS

- A. Floors: Monolithic Terrazzo.
 1. Color(s): To be selected by Architect.
 2. Aggregate Type: Marble chips.

2.02 PORTLAND CEMENT TERRAZZO FLOORING

- A. Materials:
 1. Portland Cement: ASTM C150/C150M, Type I Normal; white color for topping mix; modified to NTMA higher compressive strength requirements; obtained from single source.
 2. Color Pigments For Topping: Non-fading mineral type, alkali-resistant.
 3. Terrazzo Sand: ASTM C33/C33M, fine aggregates.
 4. Water: Potable.
 5. Surface Aggregate: Marble, free of deleterious or foreign matter.
- B. Accessories:
 1. Divider Strips: 1/8 inch thick zinc exposed top strip, zinc coated steel concealed bottom strip, with anchoring features.
 2. Divider and Control Joint Strip Height: To suit thickness of terrazzo topping, with allowance for grinding.
 3. Cleaner: Neutralizing liquid type, pH of 7 to 10.
 4. Sealer: Colorless, non-yellowing, penetrating liquid type, pH of 7 to 10; not detrimental to terrazzo components.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 PREPARATION

- A. Clean substrate of foreign matter to produce clean, dry, and neutral substrate for terrazzo application.
 1. Remove substances, including oil, grease, and curing compounds, that might impair bond of terrazzo system.

2. Roughen concrete substrates before installing terrazzo system according to NTMA's written recommendations.
- B. Protect other work from dust generated by grinding operations. Control dust to prevent air pollution and comply with environmental protection regulations.
1. Erect and maintain temporary enclosures and other suitable methods to limit dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

3.03 APPLICATION - MONOLITHIC TERRAZZO

- A. Saw cut terazzo floor slab to receive divider and control joint strips and inserts and fill with grout.
- B. Install strips straight and level to locations indicated.
- C. Install recessed floor mat frames.
- D. Place terrazzo topping mix over slurry coated substrate to a nominal thickness of 1/2 inch.

3.04 CURING

- A. Begin curing procedures as soon as curing materials can be applied without damaging formed surfaces.
- B. Close area to construction traffic, allowing undisturbed curing.

3.05 SURFACE FINISHING

- A. Surface finishing shall be for new and existing terrazzo floor areas to match level of finish.
- B. Fine Grinding: Grind with 80 grit (or finer) stones to remove grout and 120 grit diamonds until polished terrazzo-like surface is achieved. Concrete shall show a minimum of 60 percent aggregate.
- C. Brush apply terrazzo topping mix slurry to topping surface.
- D. Finish terrazzo in accordance with NTMA instructions.
- E. Grind terrazzo surface with power disc machine; successively sequence using coarse to fine grit abrasive, using a wet method.
- F. Apply grout mix matching matrix color to fill honeycomb exposed during grinding.
- G. After grout has sufficiently cured, grind repaired areas using a fine grit abrasive.

3.06 TOLERANCES

- A. Maximum Variation from Flat Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Level (Except Surfaces Sloping to Drain): 1/8 inch.

3.07 CLEANING

- A. Clean ground concrete finished areas as recommended by the manufacturer of the sealer and finisher. Machine buff terrazzo floor as required when building is ready for occupancy.
- B. Scrub and clean terrazzo surfaces with cleaner in accordance with NTMA instructions. Let dry.
- C. Seal and polish surfaces in accordance with NTMA instructions.

3.08 PROTECTION

- A. Do not permit construction traffic over finished terrazzo surfaces.

END OF SECTION

SECTION 09 68 13**TILE CARPETING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Carpet tile, as indicated in the Drawings..

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.
- C. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
- D. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
- E. Section 12 48 13 - Entrance Floor Mats and Frames

1.03 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016.
- B. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2019.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Shop Drawings: Indicate layout of joints.
- D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- E. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- 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. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.06 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Interface, Inc: www.interfaceinc.com.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. Tile Carpeting: Entropy carpet tile; Product #1464802500.
 - 1. Soil and stain resistant with 3 year extended warranty.
 - 2. Thickness: 0.12 inch.
 - 3. Color: 007201 Chameleon.
 - 4. Pattern: Non-directional.
 - 5. Primary Backing Material: CQuestBG.

2.03 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Rubber, color as selected by Architect.
- C. Adhesives:
 - 1. Compatible with materials being adhered; maximum VOC content as specified in Section 01 61 16.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet tile.
- C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- D. Vacuum clean substrate.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- F. Trim carpet tile neatly at walls and around interruptions.
- G. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 72 00**WALL COVERINGS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Wall covering and borders.
 - 1. FRP at Janitors closet.

1.02 REFERENCE STANDARDS

- A. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes; 2002 (Reapproved 2013).
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

1.03 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide data on wall covering and adhesive.
- C. Samples: Submit two samples of wall covering, 6 by 6 inch in size illustrating color, finish, and texture.

PART 2 PRODUCTS**2.01 WALL COVERINGS**

- A. General Requirements:
 - 1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
 - 2. Chemical and Stain Resistance: No visible staining or discoloration and no damage to surface texture when tested in accordance with ASTM D1308.
- B. Wall Covering: FRP Wall Panels
 - 1. Nominal Thickness: Not less than 0.09 inch.
 - 2. Trim: Manufacturer's standard two-piece, snap-on or one-piece aluminum extrusions designed to cover edges of panels.
 - a. Finish: clear anodized.
- C. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.

3.02 PREPARATION

- A. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.
- B. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

3.03 INSTALLATION

- A. Apply adhesive and wall covering in accordance with manufacturer's instructions.
- B. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.
- C. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

- A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.
- B. Reinstall wall plates and accessories removed prior to work of this section.

3.05 PROTECTION

- A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION

SECTION 09 91 13

EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Hollow metal doors and frames
 - 2. Cement board siding
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Stainless steel, galvanized steel, anodized aluminum, bronze, terne-coated stainless steel, zinc, and lead.
 - 6. Floors, unless specifically indicated.
 - 7. Glass.
 - 8. Concrete masonry units in utility, mechanical, and electrical spaces.
 - 9. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Shop-primed items.
- B. Section 09 91 23 - Interior Painting.
- C. Section 09 96 00 - High-Performance Coatings.
- D. Section 32 17 23 - Painted Pavement Markings: Painted pavement markings.

1.03 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.
- B. Gloss Levels:

1. <u>Level</u>	<u>Description</u>	<u>Gloss @ 60 degrees</u>	<u>Sheen @ 85 degrees</u>
2. Gloss Level 1	a traditional matte finish	max 5 units, and	max 10 units
3. Gloss Level 2	a 'velvet-like' finish	max 10 units, and	10 - 35 units
4. Gloss Level 3	a traditional 'egg-shell-like' finish	10 - 25 units, and	10 - 35 units

5.	Gloss Level 4	a 'satin-like' finish	20 - 35 units, and	min. 35 units
6.	Gloss Level 5	a traditional semi-gloss	35 - 70 units	
7.	Gloss Level 6	a traditional gloss	70 - 85 units	
8.	Gloss Level 7	a high gloss	more than 85 units	

1.04 REFERENCE STANDARDS

- A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.
- B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- C. SSPC V1 (PM1) - Good Painting Practice: Painting Manual, Volume 1; 2016.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years documented experience.

1.07 MOCK-UPS

- A. Locate where directed by Architect.
- B. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
 - 1. Benjamin Moore & Co.: www.benjaminmoore.com
 - 2. Miller Paint Company: www.millerpaint.com.
 - 3. Sherwin-Williams Company; _____: www.sherwin-williams.com/#sle.
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.
- B. Sheens: Provide the sheens specified for each paint system.
- C. Colors: To be selected from manufacturer's full range of available colors.
 - 1. Selection to be made by Architect after award of contract.
 - 2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.

3. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including cement board siding, pre-primed sheet metal, exterior hollow metal doors and frames, gyp board soffits, .
- B. Cement Board Siding, Exterior Latex, over Alkali Resistant Water Based Primer:
 1. Two top coats and one coat water based alkali-resistant primer.
 2. Top Coat(s): Exterior Latex; MPI #15.
 3. Top Coat Sheen:
 - a. Satin: MPI gloss level 4; use this sheen for cement board siding and pre-primed sheet metal.
 4. Primer: Alkali Resistant Water Based Primer; MPI #3..
- C. Paint GE-OP-3L - Exterior Gypsum Board and Exterior Plaster, Opaque, Latex, 3 Coat:
 1. One coat of latex primer sealer.
 2. Flat: Two coats of latex; _____.
- D. Paint ME-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
 1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
 2. Semi-gloss: Two coats of latex enamel; _____.

2.04 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.

- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Fiber Cement Siding: Remove dirt, dust and other foreign matter with a stiff fiber brush. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
- G. Ferrous Metal:
 - 1. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- H. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 09 91 23**INTERIOR PAINTING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of interior paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated. Including, but not limited to:
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Gypsum Wall Board.
 - 3. Hollow metal door frames
 - 4. Steel framing
 - 5. Mechanical and Electrical:
 - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. In finished areas, paint shop-primed items.
 - c. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
 - 6. Floors, unless specifically indicated.
 - 7. Ceramic and other tiles.
 - 8. Glass.
 - 9. Acoustical materials, unless specifically indicated.
 - 10. Concealed pipes, ducts, and conduits.
 - 11. Electrical or communications wiring

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Shop-primed items.

- B. Section 09 91 13 - Exterior Painting.
- C. Section 09 96 00 - High-Performance Coatings.
- D. Section 32 17 23 - Painted Pavement Markings: Painted pavement markings.

1.03 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

- B. Gloss Levels:

1. <u>Level</u>	<u>Description</u>	<u>Gloss @ 60 degrees</u>	<u>Sheen @ 85 degrees</u>
2. Gloss Level 1	a traditional matte finish	max 5 units, and	max 10 units
3. Gloss Level 2	a 'velvet-like' finish	max 10 units, and	10 - 35 units
4. Gloss Level 3	a traditional 'egg-shell-like' finish	10 - 25 units, and	10 - 35 units
5. Gloss Level 4	a 'satin-like' finish	20 - 35 units, and	min. 35 units
6. Gloss Level 5	a traditional semi-gloss	35 - 70 units	
7. Gloss Level 6	a traditional gloss	70 - 85 units	
8. Gloss Level 7	a high gloss	more than 85 units	

1.04 REFERENCE STANDARDS

- A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.
- B. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2017).
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- D. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- E. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- F. SCAQMD 1113 - Architectural Coatings; 1977 (Amended 2016).
- G. SSPC V1 (PM1) - Good Painting Practice: Painting Manual, Volume 1; 2016.
- H. SSPC V2 (PM2) - Systems and Specifications: Steel Structures Painting Manual, Volume 2; 2015.
- I. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- J. SSPC-SP 2 - Hand Tool Cleaning; 2018.
- K. SSPC-SP 3 - Power Tool Cleaning; 2018.
- L. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- M. SSPC-SP 13 - Surface Preparation of Concrete; 1997 (Reaffirmed 2003).

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
 - 2. MPI product number (e.g., MPI #47).
 - 3. Cross-reference to specified paint system products to be used in project; include description of each system.
- C. Samples for Initial Selection: Submit three paper chip samples, 3-1/2 by 4 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
- D. Samples for Verification:: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating selected colors, sheens, and textures for each surface finishing product scheduled.
 - 1. Label each coat of each Sample.
 - 2. Label each Sample for location and application area.
- E. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- F. Manufacturer's Instructions: Indicate special surface preparation procedures.
- G. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
 - 1. Submit operation and maintenance data in electronic and printed formats in operation and maintenance manuals per Section 01 78 00 - Closeout Submittals.
- 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.
 - 2. Extra Paint and Finish Materials: 1 gallon of each color and sheen; from the same product run, store where directed.
 - 3. Label each container with color and sheen in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years documented experience.

1.07 MOCK-UP

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Provide mock-up panel, 8 feet long by 8 feet wide for each different wall or ceiling material, illustrating paint color, texture, and finish.
- C. Provide mock-up door and frame assembly illustrating paint color, texture, and finish.

- D. Provide mock-up door and frame assembly illustrating stain and varnish color, texture, and finish.
- E. Locate where directed by Architect.
- F. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- D. Provide lighting level of 80 fc measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
 - 1. Behr Process Corporation: www.behr.com/#sle.
 - 2. Benjamin Moore: www.benjaminmoore.com
 - 3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
 - 1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.

2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 3. Supply each paint material in quantity required to complete entire project's work from a single production run.
 4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Sheens: Provide the sheens specified for each paint system.
- C. Colors: As indicated on drawings.
1. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
 2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
 3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

2.03 PAINT SYSTEMS - INTERIOR

- A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, wood, uncoated steel, shop primed steel, and galvanized steel.
1. Two top coats and one coat primer.
 2. Primer: As specified under "PRIMERS" below.
- B. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
1. Medium duty applications include doors, door frames, railings, handrails, and guardrails.
 2. Two top coats and one coat primer.
 3. Top Coat(s): Institutional Low Odor/VOC Interior Latex; [MPI #147].
 4. Top Coat Sheen:
 - a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
 5. Primer: As specified under "PRIMERS" below.
- C. Medium Duty Vertical and Overhead: Including gypsum board, concrete, concrete masonry units, uncoated steel, and shop primed steel.
1. Two top coats and one coat primer.
 2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #147.
 3. Top Coat Sheen:
 - a. Satin: MPI gloss level 4; use this sheen at all locations.
 4. Primer: As specified under "PRIMERS" below.
- D. Paint WI-OP-1L - Wood Plywood Backboards, Opaque, Latex, 1 Coat:
1. One coat of latex primer sealer.
 2. Color: White.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Vapor-Retardant Gypsum Board Latex Primer
 - a. Products:
 - (a) Sherwin-Williams PVA Drywall Primer & Sealer - B28W08000
 - (a) DFM: 1.4 mils.
 - (b) VOC Limit: 100 g/l.
 - (c) Apply only to gypsum board surfaces of exterior walls.
 - (b) Substitutions: Section 01 60 00 - Product Requirements.
 2. Interior Latex Primer Sealer; MPI #39.
 - a. Products:
 - (a) Sherwin-Williams ProMar® 200 Zero VOC Interior Latex Primer.
 - (b) Substitutions: Section 01 60 00 - Product Requirements.
 3. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
 - a. Products:
 - (a) Sherwin-Williams Pro Industrial Pro-Cryl Universal Acrylic Primer B66-310 Series.
 - (b) Substitutions: Section 01 60 00 - Product Requirements.
 4. Latex Primer for Interior Wood; MPI #39.
 - a. Products:
 - (a) Sherwin-Williams Waterbased Acrylic-Alkyd Primer B79W00450.
 - (b) Substitutions: Section 01 60 00 - Product Requirements.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
1. Gypsum Wallboard: 12 percent.
 2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Concrete:
 1. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- F. Masonry:
 1. Prepare surface as recommended by top coat manufacturer.
- G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Galvanized Surfaces:
 1. Prepare surface according to SSPC-SP 2.
- I. Ferrous Metal:
 1. Solvent clean according to SSPC-SP 1.
 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.
- J. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- K. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with tinted primer.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.

- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 09 93 00**STAINING AND TRANSPARENT FINISHING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of stains.

1.02 RELATED REQUIREMENTS

- A. Section 05 51 00 - Metal Stairs: Stained finishes for interior wood stair treads.
- B. Section 09 91 13 - Exterior Painting: Stains and transparent finishes for concrete substrates.
- C. Section 09 91 23 - Interior Painting: Stains and transparent finishes for concrete substrates.

1.03 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- D. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- E. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- F. SCAQMD 1113 - Architectural Coatings; 1977 (Amended 2016).

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and catalog number, and general product category.
 - 2. MPI product number (e.g. MPI #33).
 - 3. Manufacturer's installation instructions.
- C. Samples: Submit two samples, illustrating selected colors and sheens for each system with specified coats cascaded. Submit on sample of wood that is the same type as existing on site, or located in an area of the existing wood that will be concealed as part of the work., 3 by 8 inches in size.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with at least three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of stain or transparent finish, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Stain and Transparent Finish Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by manufacturer of stains and transparent finishes.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Provide finishes used in any individual system from the same manufacturer; no exceptions.
- B. Stains:
 - 1. Behr Process Corporation; ____: www.behr.com/#sle.
 - 2. PPG Paints; ProLuxe Stains: www.ppgpaints.com/#sle.
 - 3. Sherwin-Williams Company; ____: www.sherwin-williams.com/#sle.
 - 4. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 STAINS AND TRANSPARENT FINISHES - GENERAL

- A. Finishes:
 - 1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
 - 2. Provide finishes capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 3. Provide materials compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

4. Supply each finish material in quantity required to complete entire project's work from a single production run.
 5. Do not reduce, thin, or dilute finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
1. Provide stains and transparent finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Colors: To match the existing wood stain finish on existing beams..

2.03 INTERIOR STAIN AND TRANSPARENT FINISH SYSTEMS

- A. Finish on Wood - Existing glulam beams, and new wood indicated to match not otherwise factory finished.:
1. Stain: Semi-transparent stain for wood, water based; MPI #186.
 2. Sealer: Water based, sanding sealer, clear.
 3. Top Coat Sheen:
 - a. Eggshell: MPI gloss level 3; use this sheen at all locations.

2.04 ACCESSORY MATERIALS

- A. Accessory Materials: Cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of finished surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.

- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Existing wood surfaces that are stained shall be sanded and prepared to receive a new coat of the stain finish for an even and consistent finish appearance of all exposed areas. Remove or repair existing finishes that exhibit surface defects.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

3.03 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- D. Reinstall items removed prior to finishing.

3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

- A. Protect finishes until completion of project.

END OF SECTION

SECTION 09 96 00

HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Section includes the application of high-performance coating systems on the following substrates:
 - 1. Exterior Substrates:
 - a. Concrete, vertical surfaces.
 - b. Concrete masonry units (CMU).
 - c. Structural Steel.
- B. Surface preparation for high-performance coating systems.

1.02 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing for shop priming of metal substrates with primers specified in this Section.
- B. Section 09 91 13 - Exterior Painting: Requirements for exterior surfaces and materials not requiring a high-performance coating.
- C. Section 09 91 23 - Interior Painting: Requirements for mechanical and electrical equipment surfaces.

1.03 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.
- B. Gloss Levels:

<u>Level</u>	<u>Description</u>	<u>Gloss @ 60 degrees</u>	<u>Sheen @ 85 degrees</u>
1. Gloss Level 1	a traditional matte finish	max 5 units, and	max 10 units
2. Gloss Level 2	a 'velvet-like' finish	max 10 units, and	10 - 35 units
3. Gloss Level 3	a traditional 'egg-shell-like' finish	10 - 25 units, and	10 - 35 units
4. Gloss Level 4	a 'satin-like' finish	20 - 35 units, and	min. 35 units
5. Gloss Level 5	a traditional semi-gloss	35 - 70 units	
6. Gloss Level 6	a traditional gloss	70 - 85 units	
7. Gloss Level 7	a high gloss	more than 85 units	

1.04 REFERENCE STANDARDS

- A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.
- C. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2016.
- D. ASTM D3359 - Standard Test Method for Rating Adhesion by Tape Test; 2017.
- E. ASTM D523 - Standard Test Method for Specular Gloss; 2014 (Reapproved 2018).

- F. ASTM D661 - Standard Test Method for Evaluating Degree of Cracking of Exterior Paints; 1993 (Reapproved 2019).
- G. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2017.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- I. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- J. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- K. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.
- L. SSPC V1 (PM1) - Good Painting Practice: Painting Manual, Volume 1; 2016.
- M. SSPC V2 (PM2) - Systems and Specifications: Steel Structures Painting Manual, Volume 2; 2015.
- N. SSPC-Paint 16 - Coal Tar Epoxy-Polyamide Black (or Dark Red); 2006 (Reaffirmed 2015).
- O. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- P. SSPC-SP 2 - Hand Tool Cleaning; 2018.
- Q. SSPC-SP 3 - Power Tool Cleaning; 2018.
- R. SSPC-SP 5 - White Metal Blast Cleaning; 2007.
- S. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- T. SSPC-SP 7 - Brush-Off Blast Cleaning; 2007.
- U. SSPC-SP 10 - Near-White Blast Cleaning; 2007.
- V. SSPC-SP 11 - Power Tool Cleaning to Bare Metal; 2012, with Editorial Revision (2013).
- W. SSPC-SP 13 - Surface Preparation of Concrete; 1997 (Reaffirmed 2003).

1.05 PERFORMANCE REQUIREMENTS

- A. Provide coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
 - 1. Abrasion resistance: 65, when tested in accordance with ASTM D 968.
 - 2. Adhesion: No pick-off, when tested in accordance with ASTM D 3359 Cross Cut Tape Test, minimum rating - 4B.
 - 3. Salt spray resistance: No field blisters, Max 1/32" creepage on scribe, when tested in accordance with ASTM B-117-85 5% Salt-Fog, 10,000 hours.
 - 4. Chalking: Max. rating 8 for colors, 6 for whites, per ASTM D 659
 - 5. Accelerated Weathering:
 - a. 60/60 cycle, 500 cycles, per ASTM D 3361, with chalk rating between 9 and 10 per ASTM D 659, and Color Change no more than 10 delta E units per ASTM D 2244, and Gloss Retention of min. 60% per ASTM D 523.

- b. 5000 hours, per ASTM D 822, with chalk rating of 8 to 10 per ASTM D 659, and color change of less than 5 delta E units per ASTM D 2244, and 60% gloss retention per ASTM D 523.

1.06 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel"), VOC content, preparation requirements and application instructions.
 2. MPI product number (e.g. MPI #47).
 3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
 4. Manufacturer's installation instructions.
- C. Samples for Initial Selection: For each type of topcoat product indicated.
- D. Samples for Verification: Submit two samples 8 by 8 inches in size illustrating colors selected. Provide samples of both the thermocuring and air drying PVDF coatings.
 1. Label each coat of each Sample.
 2. Label each Sample for location and application area.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. Extra Coating Materials: 1 gallon of each type and color.
 2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.08 MOCK-UPS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Provide mock-up of each coating system indicated, 8 feet long by 8 feet wide, illustrating coating, color, and surface sheen.
- C. Locate where directed by Architect.
- D. Mock-up may remain as part of the work.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

- C. Coating Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.10 FIELD CONDITIONS

- A. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.
- B. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.
- D. Restrict traffic from area where coating is being applied or is curing.

1.11 WARRANTY

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Warranty: Provide manufacturer's limited five (5) year warranty for material. Include coverage for bond to substrate and degradation of chemical resistance.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Only materials (primers, coatings, etc.) listed in the latest edition of the MPI Approved Product List (APL) are acceptable for use on this project.
- B. Provide high performance coating products from the same manufacturer to the greatest extent possible.
 - 1. Substitution of a different high performance coating system using MPI-approved products by the same manufacturer will be considered.
- C. High-Performance Coatings:
 - 1. Benjamin Moore & Co: www.benjaminmoore.com/#sle.
 - 2. Devoe Paint Company; Akzo Nobel: www.north-america.international-pc.com/#sle.
 - 3. PPG Paints: www.ppgpaints.com/#sle.
 - 4. Sherwin-Williams Company: www.protective.sherwin-williams.com/industries/#sle.
 - 5. Tnemec Company, Inc: www.tnemec.com/#sle.
 - 6. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 HIGH-PERFORMANCE COATINGS

- A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in MPI Approved Products List.

2.03 TOP COAT MATERIALS

- A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.

- B. Elastomeric Coating for CMU Walls:
 - 1. Number of Coats: Two.
 - 2. Confirm with manufacturer compatibility of coating with existing paint on CMU
 - 3. Product Characteristics:
 - 4. Top Coat(s): Exterior Pigmented Elastomeric, Water Based; MPI #113.
 - a. Sheen: Flat.
- C. Urethane Coating for Ferrous Metals:
 - 1. Number of Coats: Two.
 - 2. Product Characteristics:
 - 3. Top Coat(s): Polyurethane, Two-Component; MPI #72, #174.
 - a. Sheen: Semi-Gloss.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by coating manufacturer.
 - 1. Block Filler, Epoxy; MPI #116.
 - 2. Rust-Inhibitive, Water Based; MPI #107.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Do not begin application of coatings until substrates have been properly prepared.
- C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.
- D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Cementitious Substrates: Do not begin application until substrate has cured 28 days minimum and measured moisture content is not greater than 12 percent.
 - 2. Gypsum Board, Plaster and Stucco: 12 percent.
 - 3. Masonry, and Concrete Unit Masonry: 12 percent.
 - 4. Wood: Do not begin application if substrate has moisture content over 12 percent.

3.02 PREPARATION

- A. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.
- B. Clean surfaces of loose foreign matter.
- C. Clean existing exterior-facing structural steel in accordance with SSPC-SP1. At steel surfaces with loose paint, including all HSS tube columns at existing glazing areas, clean in accordance with SSPC-SP1 followed by SSPC-SP3.
- D. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.
- E. Remove finish hardware, fixture covers, and accessories and store.
- F. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

3.03 PRIMING

- A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
- B. Concrete Masonry: Apply masonry filler to thickness required to fill holes and produce smooth surface; minimum thickness of 30 mils.

3.04 COATING APPLICATION

- A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in MPI - Architectural Painting and Specification Manual.
- B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

END OF SECTION

SECTION 10 14 00**SIGNAGE****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Interior directional and informational signs.
- B. Emergency evacuation maps.
- C. Building identification signs.
- D. Plaque.
- E. Traffic signs.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Allowance amount covers purchase, delivery, and installation.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- F. Verification Samples: Submit samples showing colors specified.
- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.05 QUALITY ASSURANCE

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS

- A. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 - 2. Office Doors: Identify with room names and numbers to be determined later, not those indicated on drawings; in addition, provide "window" section for replaceable occupant name.
 - 3. Conference, including Video Conference Rooms, and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
 - 4. Rest Rooms: Identify with gender neutral pictograms, the word "TOILET", and braille. For the accessible (ADA) rest rooms 118 and 208, provide accessibility symbol
- B. Interior Directional and Informational Signs:
 - 1. Sign Type: Same as room and door signs.
 - 2. Sizes: 4 inches high by 12 inches long, typical.
- C. Emergency Evacuation Maps:
 - 1. Allow for one map per floor.
 - 2. Map content to be provided by Owner.
 - 3. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.
- D. Building Identification Sign and Address Number:
 - 1. Provide custom vinyl printed signage to be applied on the exterior side of the south glazing wall of the storefront of Vestibule 101. Design and layout to be provided by Owner.
 - a. Building identification: "SKYWAY RESOURCE CENTER"
 - b. Building address number; "12610"
- E. Building Identification Sign - Existing Pole Mounted Sign:
 - 1. Provide replacement panels within existing pole mounted sign; enable to be internally back-lit
 - 2. Design to be provided by Owner.
 - 3. Coordinate sign illumination with electrician.
- F. Plaque: See Allowance for details.
- G. Code Required Signs
 - 1. Sign Type: Flat Sign

2.02 SIGN TYPES

- A. Color and Font: Unless otherwise indicated:
 - 1. Character Font: Helvetica, Arial, or other sans serif font.
 - 2. Character Case: Upper case only.
 - 3. Background Color: To be selected from manufacturer's standard colors.
 - 4. Character Color: To be selected from manufacturer's standard colors.

2.03 NON-TACTILE SIGNAGE MEDIA

- A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:
 - 1. Sign Color: Clear.
 - 2. Total Thickness: 1/8 inch.

2.04 PLAQUES

- A. Metal Plaques:
 - 1. Metal: Aluminum casting.
 - 2. Metal Thickness: 1/8 inch, minimum.

2.05 DIMENSIONAL LETTERS

- A. Metal Letters:
 - 1. Metal: Aluminum casting.
 - 2. Height: 6"
 - 3. Quantity: Assume 25 letters
 - 4. Finish: Brushed, satin.
 - 5. Mounting: Metal Stand-offs with Concealed screws.

2.06 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Exposed Screws: Stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

- D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 22 13**WIRE MESH PARTITIONS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Wire mesh systems for exterior vegetated wall..

1.02 RELATED REQUIREMENTS

- A. Section 09 91 13 - Exterior Painting.

1.03 REFERENCE STANDARDS

- A. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel; 2018.
- B. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide data for mesh materials, finishes, and attachment system.
- C. Shop Drawings: Indicate plan and vertical dimensions, elevations, component details; head, jamb, and sill details; location of hardware. Provide component details, anchorage, and type and location of fasteners.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Wire Mesh Partitions:
 - 1. Vertigrow Welded Wire Trellis System: www.vertigrowtrellissystems.com.

2.02 WIRE MESH PARTITIONS

- A. Wire Mesh Partitions: Factory-fabricated modular assemblies of panels, doors, anchors, hardware, and accessories as required to provide a complete system.
 - 1. Design Criteria:
 - a. Design partition system to provide for movement of components without damage, undue stress on fasteners or other detrimental effects, when subject to design loads.
 - b. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.03 COMPONENTS

- A. Woven Wire Mesh: Standard duty.
 - 1. Material: ASTM A510/A510M uncoated crimped steel wire.
 - 2. Wire Size: 10 gauge, 0.135 inch.
 - 3. Mesh Opening Size: 3 inch.
 - 4. Panel Nominal Size: 3'-0" tall x 4'-11 1/2" wide (field verify dimensions of structural supports and coordinate panels to fit within extents shown in drawings)
 - 5. White Powdercoat finish RAL 9010

2.04 FASTENERS

- A. Bolts, Nuts and Washers: Hot dip galvanized.
- B. Anchorage Devices: Provide power driven, powder actuated, and drilled expansion bolts.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces and required openings are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install items plumb and level, accurately fitted, free from distortion or defects.
- C. Perform field welding in accordance with AWS D1.1/D1.1M.

END OF SECTION

SECTION 10 26 00**WALL AND DOOR PROTECTION****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Corner guards at all interior outside GWB corner conditions..

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking for wall and corner guard anchors.

1.03 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.
- C. Shop Drawings: Include plans, elevation, sections, and attachment details. A schedule showing dimensions and location of each corner guard.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Corner Guards:
 - 1. Babcock-Davis: www.babcockdavis.com/#sle.
 - 2. Construction Specialties, Inc: www.c-sgroup.com/#sle.
 - 3. Nystrom, Inc: www.nystrom.com/#sle.

2.02 PRODUCT TYPES

- A. Corner Guards - Surface Mounted:
 - 1. Material: Type 304 stainless steel, No. 4 finish, 16 gauge, 0.625 inch thick.
 - 2. Width of Wings: 2 inches.
 - 3. Corner: 90 degree. Radiused 1/8 inch.
 - 4. Color: As selected from manufacturer's standard colors.
 - 5. Length: One piece, 48 inch length.

2.03 FABRICATION

- A. Fabricate components with tight joints, corners and seams.
- B. Pre-drill holes for attachment.
- C. Form end trim closure by capping and finishing smooth.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Position corner guard 4 inches above finished floor to 52 inches high.

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

SECTION 10 28 00**TOILET, BATH, AND UTILITY ROOM ACCESSORIES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Public toilet room accessories.
- B. Under-lavatory pipe supply covers.
- C. Diaper changing stations.
- D. Utility room accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Concealed supports for accessories, including in wall framing and plates.

1.03 REFERENCE STANDARDS

- A. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2004, with Editorial Revision (2016).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Samples: Submit two samples of proposed substitute for scheduled accessories, illustrating color and finish.
- D. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Commercial (Public) Toilet Room Accessories:
 - 1. ASI - American Specialties, Inc: www.americanspecialties.com.
 - 2. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
 - 3. Gamco, a division of Bobrick: www.gamcousa.com.
 - 4. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

- B. Diaper Changing Stations:
 - 1. Koala Kare Products; KB300: www.koalabear.com.
 - 2. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- C. Provide products of each category type by single manufacturer.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 PUBLIC TOILET ROOM ACCESSORIES

- A. Toilet Paper Dispenser: Multi roll, surface mounted bracket type, stainless steel, 2 theft-resistant spindles.
 - 1. Products:
 - a. Bobrick B-2888.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Paper Towel Dispenser: Electric, roll paper type.
 - 1. Cover: Translucent navy blue high-impact resin.
 - 2. Paper Discharge: Touchless automatic.
 - 3. Capacity: 6 inch diameter roll.
 - 4. Mounting: Surface mounted.
 - 5. Power: Battery operated.
 - 6. Refill Indicator: Illuminated refill indicator.
 - 7. Products:
 - a. Bobrick B-72974.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- C. Waste Receptacle: Wall-mounted, stainless steel, seamless lower door for access to container, reinforced panel full height of door, continuously welded bottom pan and seamless exposed flanges.
 - 1. Liner: Removable LinerMate receptacle.
 - 2. Products:
 - a. Bobrick B-277.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- D. Automated Soap Dispenser: Liquid soap dispenser, wall-mounted, with stainless steel cover and window to gauge soap level with surface mounted drip tray.

1. Minimum Capacity: 40 ounces.
 2. Products:
 - a. Bobrick B-2111 with B-6807.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- E. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
1. Size: 18 x 30.
 2. Frame: 1/2" inch channel shapes, with mitered and welded and ground corners; bright polished finish.
 3. Fixed Tilt Mirrors: Minimum 4 3/8 inches tilt from top to bottom.
 4. Products:
 - a. Bobrick B-165 in non-ADA restroom 119
 - b. Bobrick B-293 in ADA restrooms 118 and 208.
 - c. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- F. Seat Cover Dispenser: Stainless steel, surface-mounted, reloading by concealed opening at base, tumbler lock.
1. Minimum capacity: 250 seat covers.
 2. Products:
 - a. Bobrick B-221.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- G. Grab Bars: Stainless steel, smooth surface.
1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Finish: Satin.
 - d. Length and Configuration: As indicated on drawings.
 - e. Products:
 - (a) Bobrick B6806 x length indicated on drawings.
 - (b) Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- H. Clothes Hook: Solid aluminum casting, matte finish, with wall bumper, to be located on on the wall behind each restroom door.
1. Products:
 - a. Bobrick B-212

2.05 DIAPER CHANGING STATIONS

- A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
 - 1. Material: Polyethylene.
 - 2. Mounting: Surface.
 - 3. Color: Grey.
 - 4. Products:
 - a. Koala Kare KB300-01.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.06 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets. Locate in Janitor Room 116. .
 - 1. Drying rod: Stainless steel, 1/4 inch diameter.
 - 2. Hooks: Three, 0.06 inch stainless steel rag hooks at shelf front.
 - 3. Mop/broom holders: Four spring-loaded rubber cam holders at shelf front.
 - 4. Length: Manufacturer's standard length for number of holders/hooks.
 - 5. Products:
 - a. Bobrick B-224 x 36.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as indicated on drawings.
- D. See Section 06 10 00 - Rough Carpentry for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.
- E. Coordinate accessory locations with other work to avoid interference and to ensure proper operation and servicing of accessories. Notify the Architect in writing of any conflicts concerning product placement, for resolution. Do not proceed without resolution.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
 - 1. Grab Bars: As indicated on drawings.
 - 2. Mirrors: _____ inch, measured from floor to bottom of mirrored surface.

3.04 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 44 00**FIRE PROTECTION SPECIALTIES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Roughed-in wall openings and wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- B. FM (AG) - FM Approval Guide; current edition.
- C. NFPA 10 - Standard for Portable Fire Extinguishers; 2017, with Errata (2018).
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets, cabinet physical dimensions, rough-in measurements for recessed cabinets, locations of individual fire extinguishers, mounting measurements for wall bracket, installation procedures, and accessories required for complete installation.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.05 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Single Source: Obtain fire extinguisher cabinets from one manufacturer in compliance with IFC Section 906 "Portable Fire Extinguishers" - 2015 and NFPA 10 "Portable Fire Extinguishers" as referenced.
 - 1. Extinguishers and cabinets may be obtained from separate manufacturers,

- B. Fire Extinguishers:
 - 1. Ansul, a Tyco Business: www.ansul.com.
 - 2. Kidde, a unit of United Technologies Corp: www.kidde.com.
 - 3. Nystrom, Inc: www.nystrom.com/sle.
 - 4. Pyro-Chem, a Tyco Business: www.pyrochem.com.
 - 5. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- C. Fire Extinguisher Cabinets and Accessories:
 - 1. Kidde, a unit of United Technologies Corp: www.kidde.com.
 - 2. Nystrom, Inc: www.nystrom.com/sle.
 - 3. Potter-Roemer: www.potterroemer.com/#sle.
 - 4. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Cartridge Operated: Spun shell.
 - 2. Class: A:B:C type with UL rating 2A-10B:C or higher.
 - 3. Size: 10 pound for Corridors or on Building Exterior, and 5 pound for Living Units.
 - 4. Finish: Baked polyester powder coat, Red color.
 - 5. Temperature range: Minus 65 degrees F to 120 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

- A. Cabinet Construction for Non-Fire Rated Wall Locations:
 - 1. Formed primed steel sheet; 0.036 inch thick base metal.
- B. Cabinet Construction for Fire Rated Wall Locations: (Note: Fire rating to match assembly).
 - 1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
- C. Cabinet Configuration: Semi-recessed type for interior locations. Surface mounted type at exterior locations.
 - 1. Size to accommodate accessories.
- D. Door: 0.0652 inch (1.66mm) stainless steel, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with continuous piano hinge.
- E. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.
- F. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- G. Fabrication: Weld, fill, and grind components smooth.

- H. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
- I. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, 27 inches from finished floor to inside of bottom cabinet per ADA requirements.
- C. Secure rigidly in place.
- D. Place extinguishers in cabinets.

END OF SECTION

SECTION 10 55 00**POSTAL SPECIALTIES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Central USPS-approved mail delivery boxes.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete slab and anchor bolts for mail box.
- B. Section 05 50 00 - Metal Fabrications: Fabricated metal pedestal and anchor bolts for mail box.

1.03 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 - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, maintenance information, and current USPS approval documentation.
- C. Shop Drawings: Indicate plans for each unit or groups of units, front elevations with compartment layout and model number, overall dimensions, rough-in opening sizes, construction and anchorage details.

1.05 WARRANTY

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Provide manufacturer's warranty against defects in materials or workmanship for a period of 5 years from Date of Substantial Completion.

PART 2 PRODUCTS**2.01 CENTRAL MAIL DELIVERY BOXES**

- A. Manufacturers:
 - 1. Florence Manufacturing Company: www.florencemailboxes.com/#sle.
 - 2. Postal Products Unlimited, Inc: www.postalproducts.com/#sle.
 - 3. Salsbury Industries: www.mailboxes.com/#sle.
 - 4. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Front-Loading, USPS-Approved Horizontal Mail Receptacles: Consisting of multiple compartments with fixed, solid compartment backs, enclosed within recessed wall box. Provide access to compartments for

distributing incoming mail from front of unit by unlocking master lock and swinging side-hinged master door to provide accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door. Comply with USPS-STD-4C.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Florence "Versatile 4C Mailbox Suite D" units.
 2. Materials: Aluminum with stainless steel hardware.
 3. Finish: Powder coat in color selected by Architect from manufacturer's standard colors.
 4. Unit Types and Sizes: As 12 mailboxes minimum and 1 package box minimum.
 5. Configurations: See drawings for overall dimensions and layouts.
- C. Outdoor Parcel Lockers (OPL): Pedestal-mounted, parcel receptacle with weather-resistant cabinet for outdoor installation.
1. Unit A: Front-loading with master door, single-column design, no customer compartments, no outgoing mail receptacle, and 1 parcel compartments.

2.02 COMPONENTS

- A. Locking - Front Loading Master Door: Three-point latching mechanism with USPS master lock furnished and installed by postmaster.
- B. Locking - Customer Compartment Doors: USPS approved cam lock, 3 keys each lock.
- C. Locking - Parcel Compartment Doors: Double-lock arrangement with USPS approved cam lock for customer access, and USPS master lock furnished and installed by postmaster.
- D. Pedestals: Standard aluminum pedestal with rubber mounting pad designed to meet USPS and height requirements of ADA Standards.
- E. Pedestal Cover for Outdoor Units: Formed aluminum, classic crown design.
- F. Identification - Customer and Parcel Compartments: Sequential numerical or alphabetic characters, top to bottom, left to right; factory-installed.
 1. Silver adhesive decals, 3/4 inch high black characters centered on 1-1/2 inch high by 1-3/4 inch long decal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that concrete base and anchor bolts are ready to receive pedestal-mounted units.
- B. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

- A. Install postal specialties in accordance with approved shop drawings, manufacturer's instructions, and USPS requirements.
- B. Adjust and lubricate door hardware to operate properly.

END OF SECTION

SECTION 11 52 13**PROJECTION SCREENS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Front projection screen assemblies.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking in walls and ceilings.

1.03 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Manufacturer's catalog cuts and descriptive information on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

PART 2 PRODUCTS**2.01 FRONT PROJECTION SCREENS**

- A. Front Projection Screens: Factory assembled unless otherwise indicated.
 - 1. Dimensions: As indicated on drawings.
 - 2. Located in Meeting / Conference Room 202: Manual, matte light diffusing fabric screen, horizontally tensioned, mounted on backside of beam.
 - 3. Located in Meeting Room "The Vault": Manual, matte light diffusing fabric screen, ceiling recessed.
- B. Matte Light Diffusing Fabric: Light diffusing screen fabric; washable, flame retardant and mildew resistant.
 - 1. Material: Matte white vinyl on fiberglass backing, with nominal gain of 1.0 over viewing angle not less than 70 degrees from axis, horizontally and vertically.
 - 2. Seams: No seams permitted in fabric up to 96 inch high by 72 inch wide.
- C. Masking Borders: White, on four sides.
- D. Exposed Screen Cases: Steel, with integral roller brackets.
 - 1. Finish: Baked enamel.
 - 2. Color: White.
 - 3. End Caps: Steel; finished to match case.

4. Mounting: Wall.
- E. Concealed-in-Ceiling Screen Cases: Steel, with integral roller brackets.
 1. Door Slat: Self trim; self-closing and -opening.
 2. Case Finish: Baked enamel.
 3. Case Color: White.
 4. End Caps: Steel; finished to match case.
- F. Manually-Operated Screens:
 1. Roller: 1-3/4 inch aluminum; spring loaded with locking device.
 2. Screen Pull: Ring on bottom bar.
 3. Vertical Tensioning: Screen fabric weighted at bottom with steel bar and plastic end caps.
 4. Horizontal Tensioning: Tensioning bar.
- G. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate is finished and ready to accept screen installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that openings for recessed screens are correctly sized.
- D. Do not install projection screens until climate control systems are in place and interior painting and other finishes are completed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions, using manufacturer's recommended hardware for relevant substrates.
- B. Do not field cut screens.
- C. Install screens in mountings as specified and as indicated on drawings.
- D. Install plumb and level.
- E. Adjust projection screens and related hardware in accordance with manufacturer's instructions for proper placement and operation.

END OF SECTION

SECTION 12 24 00**WINDOW SHADES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Interior manual roller shades.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 REFERENCE STANDARDS

- A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2019.
- D. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.
- B. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
 - 2. Do not install shades until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
 - 1. Motorized Shades: Include power requirements and standard wiring diagrams for specified products.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
- D. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.
- E. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

- F. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- G. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this type with minimum five years of documented experience with shading systems of similar size and type.

1.07 MOCK-UP

- A. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams when applicable.
 - 1. Obtain Architect's approval of light and privacy characteristics of fabric prior to fabrication.
 - 2. Full-sized mock-up may become part of the final installation.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

1.09 FIELD CONDITIONS

- A. Verify blinds and fascia are coordinated with operation of windows.

1.10 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
 - 1. Shade Hardware: 25 years.
 - 2. Fabric: 10 years.
- C. Provide manufacturer's standard warranty covering Roller Shade Installation:
 - 1. One year from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Interior Manually Operated Roller Shades:
 - 1. Hunter Douglas Architectural; RB500 Manual Roller Shades: www.hunterdouglasarchitectural.com/#sle.
 - 2. MechoShade Systems LLC; Mecho/7 System: www.mechoshade.com/#sle.
 - 3. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 ROLLER SHADES

A. General:

1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
2. Provide shade system that operates smoothly when shades are raised or lowered.
3. Provide shades at exterior windows of offices, and at interior glazing between level 2 conference room and lobby. See associated details in drawings.

B. Roller Shades:

1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
 - a. Drop Position: Regular roll.
 - b. Roll Direction: Roll down, closed position is at window sill.
 - c. Mounting: Window jamb mounted - inside, between jambs.
 - d. Size: As indicated on drawings.
 - e. Fabric: As indicated under Shade Fabric article.
2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 - a. Material: Stamped steel.
3. Roller Tubes: As required for type of shade operation.
 - a. Material: Extruded aluminum, clear anodized finish.
4. Hembars: Designed to maintain bottom of shade straight and flat.
 - a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
5. Manual Operation for Interior Shades:
 - a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
 - b. Drive Chain: Continuous loop beaded ball chain, 95 lb minimum breaking strength. Provide upper and lower limit stops.
6. Accessories:
 - a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.
 - (a) Color: Aluminum.

2.03 SHADE FABRIC

- ### A. Fabric: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
1. Manufacturers:
 - a. MechoShade Systems LLC; Soho - 1600 Series (3% open): www.mechoshade.com/#sle.
 - b. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
 2. Material: 100% thermoplastic olefin.

3. Openness Factor: 3% at exterior windows of offices / Blackout at level 2 conference room..
4. Color: As selected by Architect from manufacturer's full range of colors.

2.04 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances as recommended in writing by manufacturer.
 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
 2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
- C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Install roller shades level, plumb, aligned with adjacent units, and located so shade band is not closer than 1 inch to interior face of glass.
- C. Installation Tolerances:
 1. Maximum Offset From Level: 1/16 inch.
 2. Allow clearances for window operation hardware.
- D. Adjust level, projection, and shade centering from mounting bracket. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

3.06 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 48 13**ENTRANCE FLOOR MATS AND FRAMES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Aluminum entrance floor grille.
 - 1. Entrance Floor Grille No. 1: In Vestibule 101
- B. Carpet Mat.
 - 1. Carpet Mat No. 1: Interior side of doors 101B
 - 2. Carpet Mat No. 2: Interior side of doors 117A
 - 3. Carpet Mat No. 3: Interior side of doors 201
- C. Recessed mat frames.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-In-Place Concrete: Recesses in concrete slabs as required.

1.03 REFERENCES

- A. AAMA 611-14 Voluntary Specification for Anodized Architectural Aluminum.
- B. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- C. ASTM B455-05 Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes.
- D. ASTM D2047-17 Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
- E. AWS A2.4 Standard Symbols for Welding, Brazing, and Nondestructive Examination

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide data indicating properties of walk-off surface, recessed frame characteristics.
- C. Shop Drawings: Indicate dimensions and details for recessed frame.
 - 1. For recessed frames located within a dimensionally restricted area, show dimensions of space within which the frame will be installed.
- D. Samples: Submit two samples, 6" by 6" inch in size illustrating pattern, color, finish, and edging.
- E. Maintenance Data: Include cleaning instructions, and stain removal procedures.

1.05 PROJECT CONDITIONS

- A. Verify that field measurements are as indicated.
- B. Carpet must bear the CRI (Carpet and Rug institute) Indoor Air Quality (IAQ) label.

1.06 WARRANTY

- A. A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. B. Replace defective products within a three year period after Date of Substantial Completion.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Entrance Floor Grilles and Gratings:
 - 1. Activar Construction Products Group - JL Industries; Entrance Grilles: www.activarcpg.com/#sle.
 - 2. Construction Specialties, Inc; Entrance Grids: www.c-sgroup.com/#sle.
 - 3. Nystrom, Inc; eleGRIL: www.nystrom.com/#sle.
 - 4. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Floor Mats:
 - 1. Carpet Mat: Connexus; Colorado Rib.
 - 2. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 ENTRANCE FLOOR GRILLES AND GRATINGS

- A. Entrance Floor Grilles: Recessed extruded aluminum grille with non-absorbent carpet strips inserted into longitudinal beam profiles running perpendicular to traffic flow and perimeter frame forming sides of recess; grille hinged for access to recess.
 - 1. Grilles: Longitudinal extruded beam profiles 1.25 inch, nominal, in width, 6063-T6 extruded aluminum alloy, mill finish, spaced at less than twice the bar width apart; perpendicular rails set below for stability
 - a. Tread Spacing: 1.5" on center.
 - b. Spacing Between Rails: Heelproof and ADA spacing of .125" max.
 - c. Basis of Design: Activar Construction Products Group - JL Industries; Activ-Grate 905 Series
 - 2. Grating Depth: 1 3/4" inches, nominal. Use waterproof leveling underlayment, as required, to achieve level base at required depth in slab recess.
 - 3. Length and width per plan
 - 4. Frame: Recessed angle aluminum frame for embedding in concrete; minimal exposed trim; stud or hook concrete anchors.
 - a. T063-T6 extruded aluminum alloy; 1/8" (3.2 mm) profile; 1 3/4" (15.9 mm) depth.
 - b. Finish: Mill.
 - c. Basis of Design: Activar Construction Products Group - JL Industries; Activ-Grille EG900 Series - EFRAB9: 2" frame.
- B. Mounting: Top of non-resilient members level with adjacent floor.
- C. Structural Capacity: Capable of supporting a rolling load of 400 pounds without permanent deformation or noticeable deflection.

- D. Vibration Resistant Fabrication: Rubber cushion pads.

2.03 MATS

- A. Carpet Mat No. 1, 2, and 3: 100% Asota® solution-dyed UV stabilized polypropylene fibers.
 - 1. Thickness: 3/8". Contractor to verify existing recess depth at lobby, to assure flush installation with existing terrazzo floor. Compare with adjacent carpet thickness and provide transition strip as required.
 - 2. Face Weight: 65.6 ounces/square yard.
 - 3. Colors: To be selected by Architect from manufacturer's standard range (assume 2 colors).

2.04 FABRICATION

- A. Construct recessed mat frames square, tight joints at corners, rigid. Coat surfaces with protective coating where in contact with cementitious materials.
- B. Fabricate mats in single unit sizes; fabricate multiple mats where indicated on drawings.

PART 3 EXECUTION

3.01 PREPARATION

- A. Vacuum clean floor recess.

3.02 INSTALLATION

- A. Follow manufacturer's recommendations.
- B. Install frames to achieve flush plane with adjacent finished floor surface.
 - 1. Provide necessary shims, spacers, and anchorages for proper location and secure attachment of frames to concrete.
- C. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

3.03 TOLERANCES

3.04 SCHEDULES

- A. See finish floor plans and interior finish schedule for types, locations and sizes.

END OF SECTION

SECTION 12 50 00**FURNITURE****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Bid Alternate: Common Area Furniture for the Lobby, Large Conference Room, and "the Vault" Meeting Room.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Allowances:
 - 1. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

1.03 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: For all furniture. Include product information, safety requirements, fabrics, and other materials. .

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
- B. Fabricator Qualifications: Company specializing in fabricating products specified in this section, with at least three years of documented experience.

1.05 WARRANTY

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for workmanship.. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Refer to Furnishings Presentation Attached .
- B. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

2.02 COMPONENTS

- A. Design Criteria:
 - 1. All fabrics shall be contract-grade; durability minimum 100,000 double-rubs..

PART 3 EXECUTION

3.01 INSTALLERS

- A. Contractor to install furniture in its intended location. Remove all packaging and labels..
- B. New furniture shall be free of damage and fully operational, ready for use by the public upon Substantial Completion. Report any damage or missing parts to the Architect immediately. .

3.02 CLEANING

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

3.03 PROTECTION

- A. Protect installed furnishings from subsequent construction operations.

3.04 SCHEDULES

- A. Common Areas: Furnishings.

END OF SECTION

SECTION 14 42 00**WHEELCHAIR LIFTS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. BID Alternate #3: Vertical platform wheelchair lifts.
- B. BID Alternate #3: Maintenance contract.

1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- C. ASME A17.1 - Safety Code for Elevators and Escalators; 2019.
- D. ASME A18.1 - Safety Standard for Platform Lifts and Stairway Chairlifts; 2017.
- E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2020.
- G. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2018.
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- I. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2015.
- J. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2018.
- K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
- L. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.
- M. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- N. ITS (DIR) - Directory of Listed Products; current edition.
- O. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- P. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of wheelchair lift system with adjacent construction using necessary attachments; provide anchoring devices in accordance with manufacturer's installation instructions; coordinate installation of cast-in-place concrete components.

- B. Contractor shall coordinate and obtain permit for lift construction from WA State Department of Labor and Industries.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Include data on material descriptions, construction details, component dimensions and profiles, and finishes; include data on rated capacities, electrical and operating characteristics, and necessary accessories.
- C. Shop Drawings: Include plans, elevations, sections, and attachment details; include equipment assembly details with dimensions, weights, loads, required clearances, components, size and location of anchors and required field connections, and methods for field assembly; provide diagrams indicating signal, power, and control wiring.
- D. Manufacturer's qualification statement.
- E. Maintenance contracts.
- F. Executed warranty.
- G. Project Record Documents: Accurately record actual locations of concealed items, conduits, and components.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

1.06 FIELD CONDITIONS

- A. Use of wheelchair lifts during construction for hoisting materials or personnel is not permitted.

1.07 WARRANTY

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty to repair or replace wheelchair lift system components that fail in materials or workmanship. Complete forms in Owner's name and register with manufacturer.
- C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A18.1, ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
- B. Accessibility Requirements: Comply with ADA Standards and ICC A117.1.

- C. Structural Performance: Comply with ASCE 7 for loading of wheelchair lift components and assemblies.
- D. Perform welding of steel in accordance with AWS D1.1/D1.1M.
- E. Perform electrical work in accordance with NFPA 70.

2.02 VERTICAL PLATFORM WHEELCHAIR LIFTS

- A. Manufacturers:
 - 1. Garaventa Lift; Genesis Enclosure - Vertical Platform Lift: www.garaventalift.com/#sle.
- B. Vertical Platform Wheelchair Lifts: Provide manufacturer's standard type that complies with indicated requirements. Use manufacturer's standard components for vertical platform wheelchair lifts as required for complete system unless otherwise indicated.
 - 1. Type of Vertical Platform Wheelchair Lift:
 - a. Vertical platform wheelchair lift within factory-fabricated aluminum-framed wall enclosure, and integrated doors or gates.
 - 2. Configuration:
 - a. 90-degree turn entry/exit, with front and side openings.
 - b. Number of Stops: Two.
 - c. Landing Openings, Self-Closing:
 - (a) Lower landing with enclosure-mounted door.
 - (b) Upper landing with enclosure-mounted gate.
 - 3. Location:
 - a. Interior of building, as indicated on drawings.
 - 4. Lift Load Capacity: 750 lb, maximum.
 - 5. Lifting Height from Bottom to Upper Floor Level: As indicated on drawings.
 - 6. Platform Width Clearance: 42 inches.
 - 7. Platform Length Clearance: 60 inches.
 - 8. Platform Side Wall Panels: Nominal height of 42 inches, with galvanized steel sheet panels, and enclosed within rectangular extruded aluminum framework.
 - 9. Platform Floor: Steel sheet with matte finish, having overall thickness not greater than 1-1/2 inches.
 - 10. Pit Depth: 3 inches.
 - 11. Drive System:
 - a. Roller chain hydraulic.
 - (a) Rated Speed: 17 fpm, nominal.
 - 12. Drive System Enclosure: Provide rectangular galvanized steel tube frame with flush steel sheet panels on sides and top to enclose drive system components; securely attach enclosure to adjacent substrate.
- C. Wall Enclosure Components: Prehung, non-fire-rated doors and gates suspended in structural framework with infill panels as indicated.
 - 1. Doors and Gates: Self-closing type, with flush mount.

2. Doors: Aluminum frame with clear acrylic sheet infill panels, and steel infill panels at sides adjacent to building walls .
3. Door Height: 80 inches, at landings indicated.
4. Door Width: 36 inches, at landings indicated.
5. Upper Gate: Extruded aluminum frame with 16 gauge, 0.0598 inch galvanized steel sheet lower panel kick plate, and clear acrylic sheet upper panel.
6. Gate Height: 42-1/8 inches, at upper landing.
7. Gate Width: 36 inches, at upper landing.

2.03 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics:
- B. Electrical Components, Boxes, Conduit, Wiring, and Devices: Comply with NFPA 70 and UL (DIR) or ITS (DIR) listed and labeled, and marked as applicable for proposed locations.

2.04 MATERIALS

- A. Rolled Steel Sections, Shapes, and Rods: Comply with ASTM A36/A36M.
- B. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Designation SS (structural steel), Grade 33 (230), with G90/Z275 coating.
- C. Rolled Steel Floor Plates: Comply with ASTM A786/A786M, 1/8 inch thick, with manufacturer's standard surface pattern; rolled from steel plate complying with ASTM A572/A572M, Grade 55 (380).
- D. Steel Tubing: Comply with ASTM A500/A500M, cold formed.
- E. Anchor Bolts and Rods: Comply with ASTM F1554, Grade 55.
- F. Welding: Comply with applicable requirements of AWS D1.1/D1.1M and AWS D1.3/D1.3M.

2.05 EQUIPMENT

- A. Lubrication of Equipment: Provide grease fittings for lubricating bearings requiring periodic lubrication, automatic feed type grease cups, and visible and easily accessible lubrication points.
- B. Guide Rails, Ropes, Counterweights, Sheaves, Attachment Brackets, and Anchors: Sized in accordance with local building code, including safety factors.
- C. Maintenance Devices: Provide as necessary within wheelchair lift system, supported on structural members within accessible locations.

2.06 FINISHES

- A. Provide with manufacturer custom finish for a stainless steel effect.
 1. Garaventa Exotic Finishes.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that areas and conditions comply with installation tolerances and other conditions affecting this work.

- B. Verify that locations for electrical rough-in connections to system equipment are in acceptable locations before installing equipment.
- C. Verify that electrical power is available and of correct characteristics.
- D. Do not proceed with installation until unacceptable conditions have been corrected.

3.02 INSTALLATION

- A. Install wheelchair lift system and components in accordance with manufacturer's written installation instructions.
- B. Install wheelchair lift system securely to supporting structure, and flush with adjacent surfaces.
- C. Install structural components using methods that comply with requirements indicated relative to layout and structural position.

3.03 ADJUSTING

- A. Adjust wheelchair lift equipment to operate smoothly and safely.
- B. Verify vertical travel of wheelchair lift system; adjust as necessary to maintain operating range indicated.

3.04 CLEANING

- A. Remove protective coverings from finished surfaces.
- B. Clean surfaces and components.

3.05 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate operation of wheelchair lift system to Owner's personnel.
 - 1. Use operation and maintenance data as a reference during the demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.
- B. Training: Train Owner's personnel on operation and maintenance of system.
 - 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: Manufacturer's training personnel.
 - 4. Location: At project site.

3.06 MAINTENANCE

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Provide a separate maintenance contract for service and maintenance of wheelchair lifts system and components for one year after Date of Substantial Completion.
- C. Perform maintenance work using competent personnel under supervision and in direct employment of wheelchair lift installer.
- D. Examine monthly; clean, adjust, and lubricate equipment.

- E. Repair, or replace parts when required with parts produced by original equipment manufacturer.

END OF SECTION

SECTION 22 05 13
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.
- D. Three phase electric motors.
- E. Electronically Commutated Motors (ECM).

1.02 RELATED REQUIREMENTS

- A. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.
- B. Section 26 29 13 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015.
- B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators 2004.
- C. NEMA MG 1 - Motors and Generators 2014.
- D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 5 & 20 horsepower.
- D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- E. Operation Data: Include instructions for safe operating procedures.

- F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for indoor use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- B. Comply with applicable electrical code NFPA 70 & local energy code.
- C. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of high efficiency motors.
- D. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Provide five-year manufacturer warranty for motors larger than 20 horsepower.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Baldor Electric Company/ABB Group: www.baldor.com/#sle.
- B. Lincoln Motors: www.lincolnmotors.com.
- C. A. O. Smith Electrical Products Company: www.aosmithmotors.com.
- D. Reliance Electric/Rockwell Automation: www.reliance.com.
- E. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service: Refer to Section 26 05 83 for required electrical characteristics.

B. Electrical Service:

1. Motors ½ or 3/4 HP and Smaller: 115 volts, single phase, 60 Hz.
2. Motors Larger than 1 Horsepower: 208 or 460 volts, three phase, 60 Hz.

C. Nominal Efficiency:

1. Open Motor with Two Poles: 82.5.
2. Open Motor with Four Poles: 82.5.
3. Open Motor with Six poles: 50.0.
4. Enclosed Motor with Two Poles: 75.5.
5. Enclosed Motor with Four Poles: 82.5.
6. Enclosed Motor with Six Poles: 50.0.

D. Construction:

1. Open drip-proof type except where specifically noted otherwise.
2. Design for continuous operation in 104 degrees F (40 degrees C) environment.
3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
4. Motors with frame sizes 254T and larger: Energy efficient type.

E. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

F. VFD Driven Motors: A maintenance-free, circumferential, conductive microfiber shaft grounding ring shall be installed on the motor to discharge shaft currents to ground.

G. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor efficiency.

H. Wiring Terminations:

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.

2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 APPLICATIONS

- A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.
- B. Single phase motors for shaft mounted fans and centrifugal pumps: Split phase type.
- C. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.
- D. Single phase motors for fans and pumps: Capacitor start type.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

SECTION 22 05 16
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.
- C. Pipe loops, offsets, and swing joints.

1.02 RELATED REQUIREMENTS

- A. Section 21 05 00 - Common Work Results for Fire Suppression.
- B. Section 22 10 05 - Plumbing Piping.

1.03 REFERENCE STANDARDS

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service 2015.
- B. EJMA (STDS) - EJMA Standards Tenth Edition.
- C. FM (AG) - FM Approval Guide current edition.
- D. ITS (DIR) - Directory of Listed Products current edition.
- E. UL (DIR) - Online Certifications Directory current listings at database.ul.com.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Samples: Submit two low pressure compensators in size.

- D. Design Data: Indicate selection calculations.
- E. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
- F. Maintenance Data: Include adjustment instructions.
- G. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with UL (DIR) requirements.

2.02 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

- A. Manufacturers:
 - 1. Flex-Weld, Inc: www.kelcoind.com/#sle.
 - 2. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 3. The Metraflex Company: www.metraflex.com/#sle.
 - 4. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.
 - 5. The Metraflex Company: www.metraflex.com/#sle.
- B. Inner Hose: Stainless steel, EPDM, or Bronze.
- C. Exterior Sleeve: Single braided, Double braided, stainless steel or bronze.
- D. Pressure Rating: 125 psi up to 12 inch (862 kPa up to 300 mm, DN).
- E. Maximum Service Temperature: 250 degrees F (121 degrees C).
- F. End Connections: Flanged, Threaded, Threaded with union, Welded or sweat or As specified for pipe joints.
- G. Size: Use pipe sized units.
- H. Maximum offset: 3/4 inch (20 mm) on each side of installed center line.

2.03 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Manufacturers:

1. Flex-Weld, Inc: www.kelcoind.com/#sle.
 2. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 3. The Metraflex Company: www.metraflex.com/#sle.
 4. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 psi up to 2 inch (862 kPa up to 50 mm, DN).
- E. Maximum Service Temperature: 250 degrees F (121 degrees C).
- F. End Connections: Flanged, Threaded, Threaded with union, Welded or sweat or As specified for pipe joints
- G. Size: Use pipe sized units.
- H. Maximum offset: 3/4 inch (20 mm) on each side of installed center line.
- I. Application: Copper piping.

2.04 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE

- A. Manufacturers:
1. Flex-Weld, Inc: www.kelcoind.com/#sle.
 2. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 3. The Metraflex Company: www.metraflex.com/#sle.
- B. Pressure Rating: 125 psi and 400 degrees F (862 kPa and 204 degrees C).
- C. Maximum Compression: 1-3/4 inches (45 mm).
- D. Maximum Extension: 1/4 inch (6 mm).
- E. Joint Type: Externally or Internally pressurized as specified for pipe joints with flanged ends, with threaded ends, or with welded ends.
- F. Size: Use pipe sized units.

2.05 EXPANSION JOINTS - EXTERNAL RING CONTROLLED STAINLESS STEEL BELLOWS TYPE

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 2. The Metraflex Company: www.metraflex.com/#sle.
- B. Pressure Rating: 125 psi and 400 degrees F (862 kPa and 204 degrees C).
- C. Maximum Compression: 15/16 inch (24 mm).
- D. Maximum Extension: 5/16 inch (8 mm).
- E. Maximum Offset: 1/8 inch (3 mm).
- F. End Connections: Flanged.
- G. Size: Use pipe sized units.
- H. Accessories: Internal flow liner.
- I. Application: Steel piping over 2 inches (50 mm).

2.06 EXPANSION JOINTS – SINGLE OR DOUBLE

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 2. The Metraflex Company: www.metraflex.com/#sle.
 - 3. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.
- B. Body Construction: Nylon-reinforced rubber tube or Neoprene and nylon.
- C. Pressure Rating, Sizes 3/4 Inch to 2 Inch (20 mm to 50 mm): 150 psi and 210 degrees F (1040 kPa and 99 degrees C).
- D. Pressure Rating, Sizes 1-1/2 Inch to 12 Inch (32 mm to 300 mm): << 150 psi and 250 degrees F (1040 kPa and 121 degrees C).
- E. Maximum Compression: 1/2 inch (13 mm).
- F. Maximum Elongation: 3/8 inch (10 mm).
- G. Maximum Offset: 3/8 inch (10 mm).

- H. Maximum Angular Movement: 15 degrees.
- I. Joint: Tapped steel flanges, Galvanized flanges or Galvanized unions.
- J. Size: Use pipe sized units.
- K. Application: Steel piping 2 inches (50 mm) and over.

2.07 EXPANSION JOINTS - TWO-PLY BRONZE BELLOWS TYPE

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 2. The Metraflex Company: www.metraflex.com/#sle.
- B. Construction: Bronze with anti-torque device, limit stops, internal guides.
- C. Pressure Rating: 125 psi and 400 degrees F (862 kPa and 204 degrees C).
- D. Maximum Compression: 1-3/4 inches (45 mm).
- E. Maximum Extension: 1/4 inch (6 mm).
- F. Joint: Soldered or As specified for pipe joints.
- G. Size: Use pipe sized units.
- H. Application: Copper piping.

2.08 EXPANSION JOINTS - COMPENSATORS

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 2. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.
 - 3. The Metraflex Company: www.metraflex.com/#sle.
- B. Type: Two-ply 304 stainless steel or bronze bellows with carbon steel shroud.
- C. Maximum Working Pressure: 75 psi (510 kPa).
- D. Maximum Working Temperature: 250 degrees F (121 degrees C).
- E. Maximum Compression: 1/2 inch (12.7 mm).
- F. Maximum Extension: 5/32 inch (4.0 mm).

- G. Joint: Flanged, Threaded, Soldered or As specified for pipe joints.
- H. Size: Use pipe sized units.
- I. .

2.09 EXPANSION JOINTS - STEEL WITH PACKED SLIDING SLEEVE

- A. Working Pressure and Temperature: Class 150.
- B. Joint: Flanged, Threaded, or As specified for pipe joints.
- C. Size: Use pipe sized units.
- D. Application: Steel piping 2 inches (50 mm) and over.

2.10 EXPANSION JOINTS - COPPER WITH PACKED SLIDING SLEEVE

- A. Working Pressure: 125 psi (862 kPa).
- B. Maximum Temperature: 250 degrees F (121 degrees C).
- C. Joint: Flanged, Threaded, or As specified for pipe joints.
- D. Size: Use pipe sized units.
- E. Application: Copper or steel piping 2 inches (50 mm) and over.

2.11 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

- A. Manufacturers:
 - 1. Flex-Weld, Inc: www.kelcoind.com/#sle.
 - 2. The Metraflex Company: www.metraflex.com/#sle.
 - 3. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.
- B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets and air release valve.
- C. Maximum Allowable Motion: 2 inch (50.8 mm) in the x, y, and z planes with no thrust loads to the building structure.
- D. Maximum Working Pressure: 300 psi (2065 kPa).
- E. Construction: Class 125, 150, or 300, schedule 40 or 80, stainless steel, copper, or bronze hose and single or double braid assembly with carbon steel or ductile iron fittings, including elbows

and flanged, grooved, threaded, welded, or female copper sweat end connections sized to match pipe segment.

1. Maximum Allowable Working Pressure: 300 psig (2065 kPa).
2. End Connections: Same as specified for pipe jointing.
3. Provide necessary accessories including, but not limited to, swivel joints, limit stops, internal guides, anti-torque device, internal flow liners, control rods or control cables.

2.12 EXPANSION JOINTS - EXTERNALLY PRESSURIZED

- A. Manufacturers:
 1. Flex-Weld, Inc: www.kelcoind.com/#sle.
 2. The Metraflex Company: www.metraflex.com/#sle.
 3. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.
- B. Bellows Type: Two-ply or Multi-ply bellows constructed of 321 stainless steel, 316 stainless steel, or 304 stainless steel.
- C. Internal Liner: Carbon steel with internal and external guides.
- D. Specialty: Carbon steel anchor base, lifting lugs, and drain port with tapered plug.
- E. End Connections: Class 150 or 300, carbon steel, welded, grooved, flanged, or welded flange.
- F. Maximum Axial Compression: 4 inches (102 mm).
- G. Construction: Stainless steel with anti-torque device, limit stops, internal guides.
- H. Maximum Working Pressure: 175 psi (1205 kPa).
- I. Maximum Axial Compression: 4 inches (102 mm).
- J. End Connections: Flanged end, Weld end, Grooved end, Flanged by weld end, or As specified for pipe joints.
- K. Size: Use pipe sized units.
- L. Application: Steel piping 2 inches (50 mm) and over.

2.13 ACCESSORIES

- A. Stainless Steel Pipe: ASTM A269/A269M, seamless or welded type, Grade TP304 or TP316.

- 1. -----

- 2. Note to Specifier: The stainless steel material option above is an accessory not relating to the material of the other products below.
- 3. -----

B. Pipe Alignment Guides:

- 1. Manufacturers:
 - a. Flex-Weld, Inc: www.kelcoind.com/#sle.
 - b. The Metraflex Company: www.metraflex.com/#sle.
- 2. Two-piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch (25 mm) thick insulation, minimum 3 inches (75 mm) travel.

C. Swivel Joints:

- 1. Fabricated steel, Bronze, Ductile Iron, or Cast steel body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

- F. Provide support and equipment required to control expansion and contraction of piping.
Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION

SECTION 22 05 19
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Flow meters.
- B. Pressure gauges.
- C. Thermometers.
- D. Pressure-temperature test plugs.
- E. Pressure gauges and pressure gauge taps.
- F. Thermometers and thermometer wells.
- G. Static pressure gauges.

1.02 REFERENCE STANDARDS

- A. AGA/ANSI B109 Set - INCLUDES ANSI B109.1, ANSI B109.2, ANSI B109.3, ANSI B109.4 2000.
- B. ASME B40.100 - Pressure Gauges and Gauge Attachments 2013.
- C. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi 2004 (Reaffirmed 2017).
- D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers 2014, with Editorial Revision (2017).
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2014.
- F. NSF 61 - Drinking Water System Components - Health Effects 2014 (Errata 2015).
- G. NSF 372 - Drinking Water System Components - Lead Content 2011.
- H. UL (DIR) - Online Certifications Directory current listings at database.ul.com.
- I. UL 393 - Indicating Pressure Gauges for Fire-Protection Service Current Edition, Including All Revisions.
- J. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data: Provide red-marked product data sheets for each furnished item with associated components and accessories.
- B. Project Record Documents: Record actual locations of components and instrumentation.

1.04 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS**2.01 ROTAMETERS OR FLOWMETERS**

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 - 2. McCrometer, Inc: www.mccrometer.com/#sle.
 - 3. Venture Measurement, a Danaher Corporation Company: www.venturemeasurement.com/#sle.
 - 4. VWR International, LLC: us.vwr.com/#sle.
 - 5. McCrometer, Inc: www.mccrometer.com/#sle.
- B. Calibrated venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gauge in case.
- C. Flow Sensing Element with Portable Meter.
 - 1. In-Line Averaging Measuring Station: Type 316 stainless steel pitot type flow element inserted through welded threaded couplet with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.
 - a. Pressure rating: 275 psi (1896 kPa).
 - b. Maximum temperature: 400 degrees F (204 degrees C).
 - c. Accuracy: Plus 0.55 percent to minus 2.30 percent.
 - 2. Portable Meter: Dry single diaphragm type pressure gauge with 6 inch (150 mm, DN) dial pointer, stainless steel wetted metal parts, variable pulsation damper, equalizing valve,

two bleed valves, and master chart for direct conversion of meter readings to flow rate, mounted in rust-proof carrying case with two ten foot (3 m) long rubber test hoses with brass valves or quick connections for measuring stations.

2.02 PRESSURE GAUGES

A. Manufacturers:

1. Ashcroft, Inc: www.ashcroft.com/#sle.
2. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
3. Moeller Instrument Company, Inc: www.moellerinstrument.com/#sle.
4. Omega Engineering, Inc: www.omega.com/#sle.
5. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
6. Comply with UL 393 when used for fire protection service or UL 404 when used for compressed gas service.

B. Manometers: Inclined type, red oil on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.

C. Accessories:

1. Air or Gas Sensor: Static pressure with compression fittings for bulkhead mounting and 1/8 inch (3.175 mm) diameter tubing.
2. Gauge Cock: Brass, Carbon steel, Iron, Steel, Stainless steel, or 316 stainless steel with tee or lever handle for maximum 150 psi (1034 kPa).
3. Needle Valve: Brass, Carbon steel, Steel, Stainless steel, or 303 stainless steel 1/4 inch (6 mm, DN) NPT female for noncorrosive service.

2.03 THERMOMETERS

A. Manufacturers:

1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Moeller Instrument Company, Inc: www.moellerinstrument.com/#sle.
3. Watts Water Technologies, Inc: www.watts.com/#sle.
4. Weiss Instruments, LLC: www.weissinstruments.com/#sle.

5. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
- B. General:
1. Product Compliance: ASTM E1.
 2. Lens: Clear glass or polycarbonate, except where stated.
 3. Accuracy: One percent, when tested in accordance with ASTM E77 except where stated.
 4. Scale: Black markings depicting single scale in degrees F where expected process value falls half-span of standard temperature range.
- C. Thermometers – Straight with 90-degree Back Angled Stem, 5 inch (127 mm) v-shape lead-free brass or stainless steel case with clear glass window scale, 2 inch (50.8 mm) NPT stem, 3-1/4 inch (82.5 mm) NPT thermowell, and red or blue non-toxic organic liquid filled glass tube.
- D. Thermometers - Adjustable Angle 7 inch (177.8 mm) v-shape aluminum case with clear glass window scale, 6 inch (152.4 mm) NPT stem, red or blue organic non-toxic liquid filled glass tube, and adjustable joint with positive locking device allowing 360 degrees in horizontal plane or 180 degrees in vertical plane adjustments.
- E. Thermometers - Dial Type:
1. Fixed 5 inch (125 mm) diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch (63.5 mm) NPT stem.
 - a. Remote-Local Reading: Include built-in platinum RTD probe for remote reading.
 2. Adjustable Angle, 5 inch (125 mm) diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch (63.5 mm) NPT stem.
 3. Manufacturers:
 - a. Marshall Instruments, Inc: www.marshallinstruments.com/#sle.
 - b. Reotemp Instruments Corp: reotemp.com/#sle.
 - c. Wika Instrument, LP: www.wika.us/#sle.

2.04 PRESSURE-TEMPERATURE TEST PLUGS:

- A. Size: 500 psi (34.5 bar) capacity, 1/2 inch (13 mm) MPT brass fitting with gasket, cap, and retaining strap for 1/8 inch (3 mm) pressure gauge or temperature probe.

- B. Wetted Materials per Temperature Range:
 - 1. Up to 200 degrees F (93 degrees C): Brass probe with neoprene core.
- C. Accessories: Brass, Lead-free brass, or Stainless steel ball valve, bar stock needle (valve), lever-handle cock, heavy-duty tee handle cock, siphon, snubber-filter, or tee-handle cock.
- D. Test Kit: Internally padded carrying case fitted with two 2-1/2 inch (60 mm) diameter pressure gauges, adapters, two 1/8 inch (3 mm) probes, and 1 inch (25 mm) dual-scale dial thermometers.

2.05 PRESSURE GAUGE TAPPINGS

- A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi (1034 kPa).
- B. Needle Valve: Brass, 1/4 inch (6 mm) NPT for minimum 150 psi (1034 kPa).
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch (6 mm) connections.
- D. Syphon: Steel, or Schedule 40, 1/4 inch (6 mm) angle or straight pattern.

2.06 STEM TYPE THERMOMETERS

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 - 2. Omega Engineering, Inc: www.omega.com/#sle.
 - 3. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
- B. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
 - 1. Size: 12 inch (300 mm) scale.
 - 2. Window: Clear glass.
 - 3. Calibration: Degrees F.
- C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
 - 1. Size: 12 inch (300 mm); 9 inch (225 mm) scale.

2. Window: Clear Lexan.
3. Stem: 3/4 inch (20 mm) NPT brass.
4. Accuracy: 2 percent.
5. Calibration: Degrees F.

2.07 DIAL THERMOMETERS

A. Manufacturers:

1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Omega Engineering, Inc: www.omega.com/#sle.
3. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.

B. Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.

C. Thermometers - Adjustable Angle: Dial type bimetallic actuated; ASTM E1; stainless steel case, adjustable angle with front recalibration, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.

D. Thermometers: Dial type vapor or liquid actuated; ASTM E1; stainless steel case, with brass or copper bulb, copper or bronze braided capillary, white with black markings and black pointer, glass lens.

2.08 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch (75 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.09 TEST PLUGS

A. Manufacturers:

B. Test Plug: 1/4 inch (6 mm) fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F (93 degrees C).

- C. Test Plug: 1/4 inch (6 mm) fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F (176 degrees C).

2.10 STATIC PRESSURE GAUGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 - 2. Omega Engineering, Inc: www.omega.com/#sle.
 - 3. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
- B. 3-1/2 inch (90 mm) diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- C. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Verify Utility Service Provider piping readiness to receive meter.
- B. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports, and test plugs.

3.02 INSTALLATION

- A. Install metering products in accordance with manufacturer's instructions for intended fluid type and service.
- B. Install water meters with inlet and outlet isolation valves in compliance with AWWA M6.
- C. Install gas meters in accordance with Utility Service Provider instructions with required appurtenances.
- D. Install rotameters (flowmeters) between 4 to 6 ft (1.2 to 1.8 m) above finished floor unless instructed otherwise to allow easy readability.
- E. Install pressure gauges as follows:
 - 1. At Pumps: Place single gauge before strainer, suction side and discharge side.
 - 2. Include gauge cock to isolate each gauge and extend nipples for insulation clearance.

3. Include siphons on high temperature systems and select type according to service rating.
 4. Adjust gauges to selected viewing angle, clean thoroughly, and calibrate to zero.
- F. Install thermometers as follows:
1. Hot Water Heaters: Place upstream and downstream of heater. Add one on the inlet end when using steam as the water heating medium.
 2. Piping: Install thermometers in branch butt weld connection fitting or socket-weld thermowell. Enlarge pipes smaller than 2-1/2 inch (60 mm) to accommodate sockets. Ensure sockets are above insulation clearance.
- G. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- H. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Extend nipples and siphons to allow clearance from insulation.
- I. Coil and conceal excess capillary on remote element instruments.
- J. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- K. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- L. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- M. Locate test plugs adjacent to control device sockets.

END OF SECTION

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Applications.
- B. General requirements.
- C. Angle valves.
- D. Ball valves.
- E. Check valves.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- C. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- D. Section 22 07 16 - Plumbing Equipment Insulation.
- E. Section 22 07 19 - Plumbing Piping Insulation.
- F. Section 22 10 05 - Plumbing Piping.

1.03 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.

1.04 REFERENCE STANDARDS

- A. API STD 594 - Check Valves: Flanged, Lug Wafer, and Butt-Welding 2017.
- B. ASME B1.20.1 - Pipe Threads, General Purpose (Inch) 2013.

- C. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard 2013.
- D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves 2017.
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2012.
- F. ASME B16.34 - Valves - Flanged, Threaded and Welding End 2017.
- G. ASME B31.9 - Building Services Piping 2014.
- H. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings 2015.
- I. AWWA C606 - Grooved and Shouldered Joints 2011.
- J. MSS SP-45 - Bypass and Drain Connections 2003 (Reaffirmed 2008).
- K. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends 2011.
- L. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves 2013.
- M. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010.
- N. NSF 61 - Drinking Water System Components - Health Effects 2014 (Errata 2015).
- O. NSF 372 - Drinking Water System Components - Lead Content 2011.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- E. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.

1.06 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years experience.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Secure check valves in either the closed position or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

1.08 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

- A. Handle large valves with sling, modified to avoid damage to exposed parts.
- B. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS**2.01 APPLICATIONS**

- A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- B. Provide the following valves for the applications if not indicated on drawings:
 - 1. Shutoff: Ball, butterfly, gate or plug.
 - 2. Throttling: Provide globe angle, or ball.
 - 3. Swing Check (Pump Outlet):
 - a. 2 NPS (50 DN) and Smaller: Bronze swing check valves with bronze disc.
- C. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- D. Required Valve End Connections for Non-Wafer Types:
 - 1. Steel Pipe:
 - a. 2 inch (50 mm, DN) and Smaller: Threaded ends.
 - b. Grooved-End Copper Tubing or Steel Piping.
 - 2. Copper Tube:
 - a. 2 inch (50 mm, DN) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
- E. Low Pressure, Compressed Air Valves 150 psi (1,035 kPa) or Less:
 - 1. 2 inch (50 mm, DN) and Smaller:
 - a. Bronze: Provide with solder-joint or threaded ends.
 - b. Ball: Two piece, full port, with stainless-steel trim.
 - c. Bronze Lift Check: Class 125, bronze disc.
 - d. Bronze Swing Check: Class 125, bronze disc.
 - e. Bronze Gate: Class 125.
- F. Domestic, Hot and Cold Water Valves:

1. 2 inch (50 mm, DN) and Smaller:
 - a. Bronze: Provide with solder-joint ends.
 - b. Bronze Angle: Class 125 disc.
 - c. Ball: Two full port, with stainless-steel trim.
 - d. Bronze Swing Check: Class 125 disc.
 - e. Bronze Gate: Class 125.
 - f. Bronze Globe: Class 125, bronze disc.

2.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Insulated Piping Valves: With 2 inch (50 mm, DN) stem extensions and the following features:
 1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 2. Memory Stops: Fully adjustable after insulation is installed.
- D. Valve-End Connections:
 1. Threaded End Valves: ASME B1.20.1.
 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
 3. Pipe Flanges and Flanged Fittings 1/2 inch (15 mm, DN) through 24 inch (600 mm, DN): ASME B16.5.
 4. Solder Joint Connections: ASME B16.18.
 5. Grooved End Connections: AWWA C606.
- E. General ASME Compliance:
 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 2. Solder-joint Connections: ASME B16.18.

3. Building Services Piping Valves: ASME B31.9.
- F. Potable Water Use:
1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
 2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.
- G. Bronze Valves:
1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- H. Valve Bypass and Drain Connections: MSS SP-45.
- I. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, ANGLE VALVES

- A. Class 125: CWP Rating: 200 psig: (1380 kPa).
1. Comply with MSS SP-80, Type 1.
 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
 3. End Connections: Pipe thread.
 4. Stem: Bronze.
 5. Disc: Bronze.
 6. Packing: Asbestos free.

2.04 BRASS, BALL VALVES

- A. One Piece, Full Port with Brass Trim and Push-to-fit Connections:
1. Comply with MSS SP-110.
 2. CWP Rating: 200 psi (1,379 kPa).
 3. Body: Forged brass.
 4. Seats: PTFE.
 5. Stem: Brass.

6. Ball: Chrome-plated brass.
 7. Operator: Handle.
 8. Manufacturers:
 - a. FNW: www.fnw.com/#sle.
- B. Two Piece, Full Port with Brass Trim and Female Thread, Male thread, or Solder Connections:
1. Comply with MSS SP-110.
 2. WSP Rating: 150 psi (1,035 kPa).
 3. Body: Forged brass.
 4. Seats: PTFE.
 5. Ball: Chrome-plated brass.
 6. Cap: Include cap-gasket and chain for 3/4 inch (20 mm, DN) hose connection.
 7. Operator: Lockable handle and memory stop.
 8. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. FNW 410A: www.fnw.com/#sle.
 - c. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
- C. Two Piece, Full Port with Press Connections:
1. Body: Forged brass.
 2. Seats: EPDM.
 3. Ball: Chrome-plated brass.
 4. Operator: Provide lockable handle.
 5. Manufacturers:
 - a. FNW 430: www.fnw.com/#sle.
 - b. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
- D. Three Piece, Full Port with Stainless Steel Trim:

1. Comply with MSS SP-110.
2. Body: Forged brass.
3. End Connections: Pipe thread.
4. Seats: PTFE.
5. Stem: Stainless steel.
6. Ball: Stainless steel.
7. Operator: Provide lockable handle.

2.05 BRONZE, BALL VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. One Piece, Reduced Port with Stainless Steel Trim:

1. Comply with MSS SP-110.
2. Body: Bronze.
3. End Connections: Pipe press.
4. Seats: PTFE.
5. Stem: Stainless steel.
6. Ball: Stainless steel vented.
7. Operator: Provide lockable handle.

C. Two Piece, Full Port with Bronze Trim:

1. Comply with MSS SP-110.
2. Body: Forged bronze or dezincified-brass alloy.
3. Ends Connections: Pipe thread or solder.
4. Seats: PTFE.
5. Stem: Bronze.

6. Ball: Chrome plated brass.
 7. Operator: lockable handle and stem extension.
 8. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. FNW: www.fnw.com/#sle.
 - c. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
 - d. Viega LLC: www.viega.us/#sle.
- D. Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
 2. Body: Bronze.
 3. End Connections: Pipe thread or press.
 4. Seats: PTFE.
 5. Stem: Stainless steel.
 6. Ball: Stainless steel, vented.
 7. Operator: Provide lockable handle.
 8. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. Viega LLC: www.viega.us/#sle.

2.06 BRONZE, LIFT CHECK VALVES

- A. General:
1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125:
1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat.
 2. CWP Rating: 200 psi (1,380 kPa).

3. Design: Vertical flow.
4. Body: Comply with ASTM B61 or ASTM B62, bronze.
5. Ends: Threaded or soldered as indicated.
6. Disc (Type 1): Bronze.
7. Disc (Type 2): NBR.

2.07 BRASS, INLINE CHECK VALVES

- A. Class 150:
- B. Maximum Service Temperature: 250 degrees F (121.1 degrees C).
- C. Body: Forged brass.
- D. Disc: Forged brass.
- E. Seal: PTFE, bubble-tight.
- F. End Connections: Press.
- G. Manufacturers:
 1. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
 2. FNW; X431: www.fnw.com/#sle.

2.08 BRASS, HORIZONTAL SWING CHECK VALVES

- A. Class 125, Threaded End Connections:
 1. Body: Forged brass.
 2. Disc: Forged brass.
 3. Hinge-Pin, Screw, and Cap: Forged brass.
 4. Manufacturers:
 - a. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
- B. Class 125, Press End Connections:
 1. Body: Forged brass.
 2. Disc: Forged brass.

3. Hinge-Pin, Screw, and Cap: Forged brass.
4. Manufacturers:
 - a. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.

2.09 BRONZE, SWING CHECK VALVES

- A. General:
 1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125: CWP Rating: 200 psig (1380 kPa).
 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
 2. Design: Y-pattern, horizontal or vertical flow.
 3. Body: Bronze, ASTM B62.
 4. End Connections: Threaded.
 5. Disc: Bronze.
 6. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
- C. Class 150:
 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
 2. Design: Y-pattern, horizontal or vertical flow.
 3. WSP Rating: 150 psi (1,034 kPa).
 4. Body: Bronze, ASTM B62.
 5. End Connections: Threaded or soldered.
 6. Disc: Bronze.
 7. Manufacturers:
 - a. FNW; 1241, Federal: www.fnw.com/#sle.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- D. Install check valves where necessary to maintain direction of flow as follows:
 - 1. Lift Check: Install with stem plumb and vertical.
 - 2. Swing Check: Install horizontal maintaining hinge pin level.
 - 3. Orient plate-type and center-guided into horizontal or vertical position, between flanges.

END OF SECTION

SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Prefabricated trapeze-framed systems.
- B. Strut systems for pipe or equipment support.
- C. Beam clamps.
- D. Pipe hangers.
- E. Pipe rollers and roller supports.
- F. Pipe supports, guides, shields, and saddles.
- G. Seismic bracing hardware.
- H. Nonpenetrating rooftop supports for low-slope roofs.
- I. Retrofit piping cover system.
- J. Anchors and fasteners.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 50 00 - Metal Fabrications.
- C. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

1.03 REFERENCE STANDARDS

- A. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping 2014.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2014.
- C. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999 (Reapproved 2014).
- D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.

- E. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures 1999 (Reapproved 2018).
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2015.
- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2014.
- H. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2013.
- I. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position 2014.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2015a.
- K. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2014.
- L. FM (AG) - FM Approval Guide current edition.
- M. MFMA-4 - Metal Framing Standards Publication 2004.
- N. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2009.
- O. NFPA 101 - Life Safety Code 2015.
- P. UL (DIR) - Online Certifications Directory current listings at database.ul.com.
- Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Architect of any 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 fully cured in accordance with Section 03 30 00.

1.05 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 metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
 1. Fiberglass Strut Channel Framing Systems: Include requirements for strength derating according to ambient temperature.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
 1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.
- D. Derating Calculations for Fiberglass Strut Channel Framing Systems: Indicate load ratings adjusted for applicable service conditions.
- E. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.
- F. Installer's Qualifications: Include evidence of compliance with specified requirements.
- G. 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.

1.06 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
- D. Installer Qualifications for Field-Welding: As specified in Section 05 50 00.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS**2.01 GENERAL REQUIREMENTS**

- A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
- B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.
- C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of. Include consideration for vibration, equipment operation, and shock loads where applicable.
- D. Do not use wire, chain, perforated pipe strap or wood for permanent supports unless specifically indicated or permitted.
- E. Fire Resistance: Provide hardware rated for 60 minutes resistance unless specifically indicated by the authority having jurisdiction.
- F. Vibration Isolation and Seismic Restraint Requirements: See Section 22 05 48.
- G. Materials for Metal Fabricated Supports: Comply with Section 05 50 00.
 - 1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.

2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.
- H. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.
1. Indoor Dry Locations: Use zinc-plated steel, or approved equivalent unless otherwise indicated.
 2. Outdoor, Damp, or Wet-Indoor Locations: Use galvanized steel, stainless steel or approved equivalent unless otherwise indicated.

2.02 PREFABRICATED TRAPEZE-FRAMED SYSTEMS

- A. Prefabricated Trapeze-Framed Metal Strut Systems:
1. Manufacturers:
 - a. Anvil International, LLC: www.asc-es.com/#sle.
 - b. Custom Strut and Roll Forming, LLC: www.customstrut.com/#sle.
 - c. Gripple, Inc: www.gripple.com/#sle.
 - d. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Strut Channel or Bracket Material:
 - a. Indoor Dry Locations: Use zinc-plated steel or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm).
 4. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 13/16 inch (21 mm) height.
 5. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.
- B. Prefabricated Trapeze-Framed Fiberglass Strut Systems:
1. Manufacturers:

- a. Enduro Composites: www.endurocomposites.com/#sle.
 - b. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MSS SP-58 type 59, prefabricated continuous-slot fiberglass strut channel, associated fittings, and related accessories.
 3. Channel Material: Use polyester resin or vinyl ester resin.
 4. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 1 inch (25 mm) height.
 5. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.

2.03 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

A. Strut Channels:

1. Manufacturers:
 - a. ABB Installation Products: electrification.us.abb.com/#sle.
 - b. Gripple, Inc: www.gripple.com/#sle.
 - c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.

B. Hanger Rods:

1. Threaded zinc-plated steel unless otherwise indicated.
2. Minimum Size, Unless Otherwise Indicated or Required:

- a. Equipment Supports: 1/2 inch (13 mm, DN) diameter.
 - b. Piping up to 1 inch (25 mm, DN): 1/4 inch (6 mm, DN) diameter.
 - c. Piping larger than 1 inch (25 mm, DN): 3/8 inch (10 mm, DN) diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch (10 mm) in length.
- C. Channel Nuts:
1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7821: www.fnw.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.
- D. Cable Hanging System Kits:
1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. Ductmate Industries, Inc: ductmate.com/#sle.
 - c. Gripple, Inc: www.gripple.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Provide cable-wire in bulk or pre-cut lengths with respective cable hangers as required to hold minimum weight of 120 lb (54.4 kg).
 3. Accessories: Provide brackets, clip or c-clip hangers, covers, and y-hook hangers.

2.04 BEAM CLAMPS

- A. Manufacturers:
1. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.

2. FNW; 7201: www.fnw.com/#sle.
 3. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 4. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- B. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
- C. C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
- D. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
- E. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
- F. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
- G. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish.
- H. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- I. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.05 PIPE HANGERS

- A. Band Hangers, Adjustable:
1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. Gripple, Inc: www.gripple.com/#sle.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. MSS SP-58 type 7 or 9, zinc-plated ASTM A1011/A1011M steel, ASTM A653/A653M, or carbon steel.
- B. J-Hangers, Adjustable:
1. Manufacturers:

- a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7025: www.fnw.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MSS SP-58 type 5, zinc-plated ASTM A1011/A1011M steel, ASTM A653/A653M, or carbon steel.
 3. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.
- C. Swivel Ring Hangers, Adjustable:
1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7010: www.fnw.com/#sle.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. MSS SP-58 type 10, epoxy-painted, zinc-colored.
 3. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 4. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
 5. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.
- D. Clevis Hangers, Adjustable:
1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7005: www.fnw.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
 3. Felt-Lined: MSS SP-58 type 1, zinc-plated, silicone-free carbon steel.
 4. Light-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
 5. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
 6. UL (DIR) listed: Pipe sizes 2-1/2 to 8 inch (65 to 200 mm, DN).
 7. FM (AG) listed: Pipe sizes 2-1/2 to 8 inch (65 to 200 mm, DN).
- E. Nonmetallic Pipe Hangers:
1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. DecoShield Systems, Inc: www.decoshield.com/#sle.
 - c. Gregory Industries, Inc: www.gregorycorp.com/#sle.
 2. CPVC fabricated, snap-action hanger for pendant or sidewall applications.

2.06 PIPE CLAMPS

- A. Riser Clamps:
1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7020: www.fnw.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
 3. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.

5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch (15 to 200 mm, DN).
- B. Extension Split Pipe Clamp:
1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7001: www.fnw.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. MSS SP-58 type 12, hinged split ring and yoke roller hanger with epoxy copper, plain, or zinc finish.
 3. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
 4. Provide hanger rod and nuts of the same type and material for a given pipe run.
 5. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- C. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.
- D. Strut Clamps:
1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7815: www.fnw.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
 3. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil (26,398,000 V/m).

E. Insulation Coupling:

1. Manufacturers:
 - a. FNW; 7897: www.fnw.com/#sle.
 - b. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Two bolt-type clamps designed for installation under insulation.
3. Material: Carbon steel with epoxy copper or zinc finish.

2.07 PIPE ROLLERS AND ROLLER SUPPORTS

A. Manufacturers:

1. ASC Engineered Solutions: www.asc-es.com/#sle.
2. FNW; 7902: www.fnw.com/#sle.
3. nVent Caddy, a brand of nVent: www.erico.com/#sle.
4. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

B. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.

C. Steel Yoke Type: MSS SP-58 type 44, vertically adjustable, nonconductive, and corrosion resistant.

D. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

2.08 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

B. Stanchions:

1. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.

- b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 3. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
 4. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
- C. U-Bolts:
 1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7610: www.fnw.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. MSS SP-58 type 24, carbon steel u-bolt for pipe support or anchoring.
- D. Intermediate Anchors and Pipe Alignment Guides:
 1. Manufacturers:
 - a. Anvil International, LLC: www.anvilintl.com/#sle.
 - b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - c. Gregory Industries, Inc: www.gregorycorp.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Pipe Sizes 6 inch (150 mm, DN) and Smaller: Minimum clearance of 0.16 inch (4 mm).
 3. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.

E. Pipe Alignment Guides, Galvanized steel:

1. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.
 - b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - c. Gregory Industries, Inc: www.gregorycorp.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

F. Pipe Shields for Insulated Piping:

1. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.
 - b. FNW; 7753: www.fnw.com/#sle.
 - c. Gregory Industries, Inc: www.gregorycorp.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
3. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

G. Pipe Supports:

1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
2. Liquid Temperatures Up to 122 degrees F (50 degrees C):
 - a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
 - b. Support From Below: MSS SP-58 types 35 through 38.

H. Pipe Supports, Thermal Insulated:

1. Manufacturers:

- a. Buckaroos, Inc: www.buckaroos.com/#sle.
- b. KB Enterprises: www.snappitz.com/#sle.

2. General Requirements:

- a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- b. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
- c. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
- d. Provide pipe supports for 1/2 to 30 inch (15 to 750 mm, DN) iron pipes.
- e. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.

3. PVC Jacket:

- a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
- b. Moisture Vapor Transmission: 0.0071 perm inch (0.0092 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
- c. Minimum Thickness: 60 mil, 0.06 inch (1.524 mm).
- d. Connections: Brush-on welding adhesive.

4. Products:

- a. Buckaroos, Inc: www.buckaroos.com/#sle.

I. Copper Pipe Supports:

1. Manufacturers:

- a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.

- b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - c. Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by single manufacturer.
- J. PEX Pipe Supports:
 - 1. Manufacturers:
 - a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - b. Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by single manufacturer.
- K. CPVC Pipe Supports:
 - 1. Manufacturers:
 - a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - b. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- L. Thermal Insulated, Surface-Mounted Pipe Supports:
 - 1. Manufacturers:
 - a. FNW; 7701: www.fnw.com/#sle.
 - b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Material: Carbon steel with epoxy copper or zinc finish.
 - 3. Weather and UV light resistant foam, plastic, or rubber material with built-in strut.
Maximum Load: 50 lb (22.7 kg) for single pipe or multiple landed on top strut.
- M. Overhead Pipe Supports:
 - 1. Manufacturers:
 - a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - b. nVent Caddy, a brand of nVent: www.erico.com/#sle.

- c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

N. Plenum Pipe Supports:

1. Manufacturers:

- a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
- b. nVent Caddy, a brand of nVent: www.erico.com/#sle.
- c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

O. Telescoping Pipe Supports:

1. Manufacturers:

- a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
- b. nVent Caddy, a brand of nVent: www.erico.com/#sle.
- c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2.09 SEISMIC BRACING HARDWARE

A. Cable Suspension Systems:

1. Manufacturers:

- a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
- b. nVent Caddy, a brand of nVent: www.erico.com/#sle.
- c. Gripple, Inc: www.gripple.com/#sle.
- d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. Strut channel or bracket-fitted fitting with locking mechanism for pipe or equipment suspension using cable wires extended to surface-mounted end-fixing fittings.

3. Provide cable wire and end-fixing as required to hold minimum weight of 120 lb (54.4 kg).

B. Cable Sway Bracing Systems:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - c. Gripple, Inc: www.gripple.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Cable wire hanger with fix and release spring mechanism enclosed using zinc housing with 302 stainless steel components for pipe or equipment suspension to surface-mounted end-fixing fittings.
3. Provide cable wire and end-fixing as required to hold minimum weight of 25 lb (11.3 kg).

2.10 NONPENETRATING ROOFTOP SUPPORTS FOR LOW-SLOPE ROOFS

- A. Manufacturers:
 1. Anvil International: www.anvilintl.com/#sle.
 2. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 3. nVent Erico, a brand of nVent: www.erico.com/#sle.
 4. PHP Systems/Design: www.phpsd.com/#sle.
 5. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 6. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2.11 ANCHORS AND FASTENERS

- A. Manufacturers - Mechanical Anchors:
 1. FNW; 7502: www.fnw.com/#sle.
 2. Hilti, Inc: www.us.hilti.com/#sle.
 3. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 4. Powers Fasteners, Inc: www.powers.com/#sle.
 5. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.

- B. Manufacturers - Powder-Actuated Fastening Systems:
 - 1. Hilti, Inc: www.us.hilti.com/#sle.
 - 2. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
 - 3. Powers Fasteners, Inc: www.powers.com/#sle.
 - 4. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
- C. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
- D. Concrete: Use preset concrete inserts, expansion anchors or screw anchors.
- E. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- F. Wood: Use wood screws.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

- G. Field-Welding (where approved by Architect): Comply with Section 05 50 00.
- H. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- 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 3 inch (80 mm) high concrete pad constructed in accordance with 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. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- K. Secure fasteners according to manufacturer's recommended torque settings.
- L. Remove temporary supports.

3.03 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

SECTION 22 05 48**22 05 48-VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Vibration isolation requirements.
- B. Seismic control requirements.
 - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- C. Vibration-isolated equipment support bases.
- D. Vibration isolators.
- E. External seismic snubber assemblies.
- F. Seismic restraint systems.
- G. Vibration-isolated and/or seismically engineered roof curbs.

1.02 RELATED REQUIREMENTS

- A. Section 01 45 33 - Code-Required Special Inspections and Procedures.
- B. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

1.03 DEFINITIONS

- A. Plumbing Component: Where referenced in this section in regards to seismic controls, applies to any portion of the plumbing system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures 2010, with 2013 Supplements and Errata.
- B. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications 2015.

- C. FEMA 414 - Installing Seismic Restraints for Duct and Pipe 2004.
- D. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage 2011.
- E. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components 2010, with Editorial Revision (2015).
- G. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; Sheet Metal and Air Conditioning Contractors' National Association 2008.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Seismic Controls:
 - a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
 - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
 - 5. Notify Architect of any 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 fully cured in accordance with Section 03 30 00.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
 - 2. Seismic Controls: Include seismic load capacities.
- D. Shop Drawings - Vibration Isolation Systems:
 - 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
 - 2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
- E. Shop Drawings - Seismic Controls:
 - 1. Include dimensioned plan views and sections indicating proposed plumbing component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
 - 2. Identify mounting conditions required for equipment seismic qualification.
 - 3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
 - 4. Indicate proposed arrangement of distributed system trapeze support groupings.
 - 5. Indicate proposed locations for distributed system flexible fittings and/or connections.
 - 6. Indicate locations of seismic separations where applicable.
 - 7. Include point load drawings indicating design loads transmitted to structure at each attachment location.
- F. Seismic Design Data:
 - 1. Compile information on project-specific characteristics of actual installed plumbing components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.

2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.
- G. Certification for seismically qualified equipment; identify basis for certification.
- H. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.
- I. 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.
- J. Evidence of qualifications for seismic controls designer.
- K. Evidence of qualifications for manufacturer.
- L. Manufacturer's detailed field testing and inspection procedures.
- M. Field quality control test reports.

1.07 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
 1. Designer may be employed by the manufacturer of the seismic restraint products.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS**2.01 VIBRATION ISOLATION REQUIREMENTS**

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing plumbing equipment and/or plumbing connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 - 1. Select vibration isolators to provide required static deflection.
 - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
 - 3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
 - 4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
 - 5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch (50 mm) operating clearance beneath base unless otherwise indicated.
- D. Equipment Isolation:
 - 1. Equipment Type.
 - a. Location: Indoor.
 - b. Mounting: Vibration-isolated structural steel base.
 - c. Isolator Type (Nonseismic Application): Restrained spring isolators.
 - d. Isolator Type (Seismic Application): Seismic type restrained spring isolators.
- E. Piping Isolation:
 - 1. Provide vibration isolators for piping supports:
 - a. Located in equipment rooms.

- b. Located within 50 feet (15.2 m) of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
 - c. For piping over 2 inch (50 mm) 50 feet (15.2 m) of noise-sensitive areas indicated.
2. Minimum Static Deflection:
- a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch (50 mm) deflection required.
 - b. Remainder of Supports: 0.75 inch (19 mm) deflection unless otherwise indicated.
3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
4. Suspended Piping, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
5. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
6. Floor-Mounted Piping, Seismic Applications: Use seismic type restrained spring isolators.
7. Use modular seal or approved resilient material where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

2.02 SEISMIC CONTROL REQUIREMENTS

- A. plumbing component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor plumbing components.
- B. Seismic Design Criteria: ICC (IBC).
 - 1. --CHOOSE ONE OF THE TWO PARAGRAPHS BELOW FOR IBC/ASCE 7 PROJECTS; THE FIRST PARAGRAPH IS FOR RISK CATEGORY IV (ESSENTIAL FACILITIES)--
- C. Component Importance Factor (I_p): Plumbing components to be assigned a component importance factor (I_p) of 1.5 unless otherwise indicated.
- D. Seismic Qualification of Equipment:

1. Provide special certification for plumbing equipment furnished under other sections and assigned a component importance factor (I_p) of 1.5, certifying that equipment will remain operable following a design level earthquake.
 2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
 3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- E. Seismic Restraints:
1. Provide seismic restraints for plumbing components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
 2. Seismic Restraint Exemptions:
 - a. Exemptions for Seismic Design Category C:
 - 1) Plumbing components where either of the following apply:
 - a) The component importance factor (I_p) is 1.0 and the component is positively attached to the structure.
 - b) The component weighs 20 pounds (89 N) or less or, in the case of a distributed system, 5 pounds per foot (73 N/m) or less.
 - 2) Plumbing piping with component importance factor (I_p) of 1.5 and nominal pipe size of 2 inch (50 mm) or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
 - b. Exemptions for Seismic Design Category D, E, and F:
 - 1) Discrete plumbing components that are positively attached to the structure where either of the following apply:

- a) The component weighs 400 pounds (1,780 N) or less, has a center of mass located 4 feet (1.22 m) or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor (I_p) is 1.0.
 - b) The component weighs 20 pounds (89 N) or less or, in the case of a distributed system, 5 pounds per foot (73 N/m) or less.
- 2) Plumbing piping with component importance factor (I_p) of 1.0 and nominal pipe size of 3 inch (80 mm) or less, or with component importance factor (I_p) of 1.5 and nominal pipe size of 1 inch (25 mm) or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
- c. Plumbing Piping Exemptions, All Seismic Design Categories:
- 1) Plumbing piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:
 - a) Trapeze supported piping weighing less than 10 pounds per foot (146 N/m), where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.
 - b) Trapeze supported piping with trapeze assemblies using 3/8 inch (10 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds (445 N) or less.
 - c) Trapeze supported piping with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific

seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds (890 N) or less.

- d) Trapeze supported piping with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 24 inches (610 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds (445 N) or less.
- e) Hanger supported piping with individual rod hangers 3/8 inch (10 mm) or 1/2 inch (13 mm) in diameter not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where pipe has a component importance factor (I_p) of 1.0 and meets size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds (220 N) or less.

F. Seismic Attachments:

1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES), or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use friction clips (devices that rely on mechanically applied friction to resist loads) except where permitted by applicable code. Beam clamps may be used for supporting sustained loads where provided with restraining straps.
4. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
5. Concrete Housekeeping Pads:
 - a. Increase size of pad as required to comply with anchor requirements.
 - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

G. Seismic Interactions:

1. Include provisions to prevent seismic impact between plumbing components and other structural or nonstructural components.
2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.

H. Seismic Relative Displacement Provisions:

1. Use suitable fittings or flexible connections to accommodate:
 - a. Relative displacements at connections between components, including distributed systems (e.g., piping); do not exceed load limits for equipment utility connections.
 - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
 - c. Design displacements at seismic separations.
 - d. Anticipated drifts between floors.

I. Manufacturers:

1. Vibration-Isolated Equipment Support Bases:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

J. Vibration-Isolated Structural Steel Bases:

1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.

K. Vibration-Isolated Concrete Inertia Bases:

1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.

2. Minimum Base Depth: 6 inches (152 mm).
3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
5. Concrete: Filled on site with minimum 3000 psi (20 mPa) concrete in accordance with Section 03 30 00.
6. Pump Applications: Size and configure bases for piping elbow supports as required.

2.03 VIBRATION ISOLATORS

A. Manufacturers:

1. Vibration Isolators:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:

1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.

- f. Selected to function without undue stress or overloading.
3. Seismic Snubbing Elements for Seismic Isolators:
- a. Air Gap: Between 0.125 inches (3 mm) and 0.25 inches (6 mm) unless otherwise indicated.
 - b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch (6 mm) thick; capable of being visually inspected for damage and replaced.
- C. Vibration Isolators for Nonseismic Applications:
1. Resilient Material Isolator Pads:
- a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) isolator material.
 - b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch (6 mm) thickness.
 - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
2. Resilient Material Isolator Mounts, Nonseismic:
- a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber), or fiberglass isolator material fail-safe type.
3. Open (Unhoused) Spring Isolators:
- a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
 - b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
4. Housed Spring Isolators:
- a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.

- b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
 - c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - d. Furnished with integral leveling device for positioning and securing supported equipment.
5. Restrained Spring Isolators, Nonseismic:
- a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
 - b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
 - d. Provides constant free and operating height.
6. Resilient Material Isolator Hangers, Nonseismic:
- a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection.
7. Spring Isolator Hangers, Nonseismic:
- a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
8. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
- a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the

lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection.

- b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

D. Vibration Isolators for Seismic Applications:

1. Resilient Material Isolator Mounts, Seismic:

- a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.

2. Restrained Spring Isolators, Seismic:

- a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
- b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
- c. Furnished with integral leveling device for positioning and securing supported equipment.
- d. Provides constant free and operating height.

3. Resilient Material Isolator Hangers, Seismic:

- a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.

4. Spring Isolator Hangers, Seismic:

- a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.

- b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
- a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

2.04 ACOUSTICAL AND VIBRATION ISOLATORS

A. Manufacturers:

- 1. Acoustical and Vibration Isolators:
 - a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
- 2. Source Limitations: Furnish isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:

- 1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

2.05 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

A. Manufacturers:

- 1. External Seismic Snubber Assemblies:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.

2. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.
- C. Seismic Snubbing Elements:
1. Air Gap: Between 0.125 inches (3 mm) and 0.25 inches (6 mm) unless otherwise indicated.
 2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch (6 mm) thick; capable of being visually inspected for damage and replaced.

2.06 SEISMIC RESTRAINT SYSTEMS

- A. Manufacturers:
1. Seismic Restraint Systems:
 - a. AFCON, a brand of Anvil International: www.anvilintl.com/#sle.
 - b. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - c. Mason Industries: www.mason-ind.com/#sle.
 2. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.
- B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- C. Cable Restraints:
1. Comply with ASCE 19.
 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
 4. Use protective thimbles for cable loops where potential for cable damage exists.

- D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

2.07 VIBRATION-ISOLATED AND/OR SEISMICALLY ENGINEERED ROOF CURBS

A. Manufacturers:

1. Vibration-Isolated and/or Seismically Engineered Roof Curbs:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
2. Source Limitations: Furnish vibration-isolated roof curbs and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. Vibration Isolation Curbs:

1. Nonseismic Curb Rail:
 - a. Location: Between existing roof curb and rooftop equipment.
 - b. Construction: Aluminum.
 - c. Integral vibration isolation to comply with requirements of this section.
 - d. Weather exposed components consist of corrosion resistant materials.
2. Nonseismic Curb:
 - a. Location: Between structure and rooftop equipment.
 - b. Construction: Aluminum.
 - c. Integral vibration isolation to comply with requirements of this section.
 - d. Weather exposed components consist of corrosion resistant materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.

- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Field-Welding (where approved by Architect): Comply with Section 05 50 00.
- E. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- F. Vibration Isolation Systems:
 - 1. Vibration-Isolated Equipment Support Bases:
 - a. Provide specified minimum clearance beneath base.
 - 2. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.
 - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
 - 3. Isolator Hangers:
 - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
 - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
 - 4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.

5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
6. Adjust isolators to be free of isolation short circuits during normal operation.
7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

G. Seismic Controls:

1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris, or other obstructions.
2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch (3 mm), use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch (3 mm) or less.
4. Equipment with Sheet Metal Housings:
 - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
 - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
 - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
5. Concrete Housekeeping Pads:
 - a. Size in accordance with seismic design to meet anchor requirements.
 - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
6. Seismic Restraint Systems:
 - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
 - b. Install restraints within permissible angles in accordance with seismic design.

- c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
- d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
- e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.
- D. Vibration Isolation Systems:
 - 1. Verify isolator static deflections.
 - 2. Verify required clearance beneath vibration-isolated equipment support bases.
 - 3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- E. Seismic Controls:
 - 1. Verify snubbing element air gaps.
- F. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
- G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers.
- E. Ceiling tacks.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems 2007.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2013.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Schedules:
 - 1. Submit plumbing component identification schedule listing equipment, piping, and valves.
 - 2. Detail proposed component identification data in terms of wording, symbols, letter size, and color coding to be applied to corresponding product.
 - 3. Valve Data Format: Include id-number, location, function, and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Samples: Submit two labels in size.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS**2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE**

- A. Nameplates:
 - 1. Heat exchangers, water heaters, and other heat transfer products.
 - 2. Control panels, transducers, and other related control equipment products.
 - 3. Pumps, tanks, filters, water treatment devices, and other plumbing equipment products.
- B. Tags:
 - 1. Piping: 3/4 inch (20 mm) diameter and smaller.
 - 2. Manual operated and automated control valves.
 - 3. Instrumentation, relays, gauges, and other related control equipment products.
 - 4. Ceiling tacks placed on lay-in ceiling surface to reference plumbing components.
- C. Stencil:
 - 1. Piping: 3/4 inch (20 mm) diameter and higher.
 - 2. Heat exchangers, water heaters, and other heat transfer products.
 - 3. Pumps, tanks, filters, water treatment devices, and other fluid managing products.
 - 4. Ceiling tacks placed on lay-in ceiling surface to reference plumbing components.
- D. Pipe Markers: 3/4 inch (20 mm) diameter and higher.

2.02 IDENTIFICATION APPLICATIONS

- A. Heat Transfer Equipment: Nameplates.
- B. Instrumentation: Tags.
- C. Major Control Components: Nameplates.
- D. Piping: Tags.
- E. Pumps: Nameplates.
- F. Tanks: Nameplates.
- G. Thermostats: Nameplates.

- H. Valves: Tags and ceiling tacks where located above lay-in ceiling.
- I. Water Treatment Devices: Nameplates.

2.03 NAMEPLATES

- A. Manufacturers:
 - 1. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 3. Seton Identification Products: www.seton.com/#sle.
- B. Description: Laminated piece with up to three lines of text.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/4 inch (6 mm).
 - 3. Background Color: Black.
 - 4. Nameplate Height: 3/4 inch (19 mm).
 - 5. Nameplate Material:
 - a. Flexible: Vinyl with adhesive backing per ASTM D709.
 - b. Metal: Brass with center-side holes for screw fastening.
 - 6. Plastic: Comply with ASTM D709.

2.04 TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving: www.advancedgraphicengraving.com/#sle.
 - 2. Brady Corporation: www.bradycorp.com/#sle.
 - 3. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 4. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 - 5. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 6. Seton Identification Products: www.seton.com/#sle.
 - 7. _____.

8. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Flexible: Vinyl with engraved black letters on light contrasting background color with up to three lines of text. Minimum tag size 1-1/2 inch (40 mm) in diameter.
- C. Metal Tags: Stainless Steel with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.
- D. Valve Tag Chart: Typewritten 12-point letter size list in anodized aluminum frame.
- E. Piping: 3/4 inch (20 mm) diameter and smaller. Include corrosion resistant chain. Identify service, flow direction, and pressure.

2.05 STENCILS

- A. Manufacturers:
 1. Brady Corporation: www.bradycorp.com/#sle.
 2. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 3. Insite Solutions, LLC: www.stop-painting.com/#sle.
 4. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com/#sle.
 5. Seton Identification Products: www.seton.com/#sle.
- B. Pipe: Stencil size required per external insulated or uninsulated pipe diameter.
 1. 3/4 to 1-1/4 inch (20 to 30 mm) Range: 1/2 inch (15 mm) text over 8 inch (200 mm) long background.
 2. 1-1/2 to 2 inch (40 to 50 mm) Range: 3/4 inch (20 mm) text over 8 inch (200 mm) long background.
 3. 2-1/2 to 6 inch (65 to 150 mm) Range: 1-1/4 inch (30 mm) text over 12 inch (300 mm) long background.
- C. Equipment: Use 2-1/2 inch (65 mm) text.
- D. Background Paint: Semi-gloss enamel in compliance with Section 09 91 23.
- E. Stencils: With clean cut symbols and letters of following size:
 1. 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.

- F. Stencil Paint: As specified in Section 09 91 23, semi-gloss enamel, colors complying with ASME A13.1.

2.06 PIPE MARKERS

- A. Manufacturers:
1. Brady Corporation: www.bradycorp.com/#sle.
 2. Brimar Industries, Inc: www.pipemarker.com/#sle.
 3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 5. Seton Identification Products: www.seton.com/#sle.
- B. Comply with ASME A13.1.
- C. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.
- D. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- E. Underground Flexible Marker: Bright-colored continuously printed ribbon tape, minimum 6 inches (150 mm) wide by 4 mil, 0.004 inch (0.10 mm) thick, manufactured for direct burial service.
- F. Identification Scheme, ASME A13.1:
1. Primary: External Pipe Diameter, Uninsulated or Insulated.
 - a. 3/4 to 1-1/4 inches (19 to 32 mm): Use 8 inch (203 mm) field-length with 1/2 inch (13 mm) text height.
 - b. 1-1/2 to 2 inches (38 to 51 mm): Use 8 inch (203 mm) field-length with 3/4 inch (19 mm) text height.
 - c. 2-1/2 to 6 inches (64 to 152 mm): Use 12 inch (305 mm) field-length with 1-1/4 inch (32 mm) text height.
 2. Secondary: Color scheme per fluid service.
 - a. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.
 3. Tertiary: Other Details.

2.07 UNDERGROUND WARNING TAPE

- A. Manufacturers:
 - 1. Brady Corporation: www.bradyid.com/#sle.
 - 2. Brimar Industries, Inc: www.brimar.com/#sle.
 - 3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 4. Seton Identification Products: www.seton.com/#sle.
- B. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
 - 1. Exception: Use foil-backed detectable type tape where required by serving utility or where directed by Owner.
- C. Legend: Type of service, continuously repeated over full length of tape.

2.08 CEILING TACKS

- A. Manufacturers:
 - 1. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
- B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.
- C. Color code as follows:
 - 1. Plumbing Equipment: Yellow.
 - 2. Plumbing Valves: Green.
 - 3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive identification products.
- B. Prepare surfaces for stencil painting, see Section 09 91 23.

3.02 INSTALLATION

- A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

- B. Install tags in clear view and align with axis of piping.
- C. Apply stencil painted identification in compliance with Section 09 91 23 requirements. Identify unit with assigned id-number and area being served using pipe marking rules.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
- G. Apply ASME A13.1 Pipe Marking Rules:
 - 1. Place pipe marker adjacent to changes in direction.
 - 2. Place pipe marker adjacent each valve port and flange end.
 - 3. Place pipe marker at both sides of floor and wall penetrations.
 - 4. Place pipe marker every 25 to 50 feet (7.6 to 15.2 m) interval of straight run.
- H. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.
 - 3. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- I. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 22 07 16
PLUMBING EQUIPMENT INSULATION**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Flexible elastomeric cellular insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Hydrous calcium silicate insulation.
- D. Jacketing and accessories.
- E. Equipment insulation.
- F. Covering.

1.02 RELATED REQUIREMENTS

- A. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- B. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric] 2014.
- D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2013.
- E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement 2007 (Reapproved 2013).
- F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2010.
- G. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation 2013.

- H. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2014.
- I. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013.
- J. ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service 2010 (Reapproved 2015).
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2015a.
- L. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2014.
- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.
- C. Samples: Submit two samples of any representative size illustrating each insulation type.
- D. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.
- B. Applicator 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.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS**2.01 REGULATORY REQUIREMENTS**

- A. Comply with requirements in the schedule(s), plan(s), & package accompanying this document.
- B. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, or UL 723, when mounted per ASTM E 2231, 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. Formaldehyde Free: Third party certified with UL Environment Validation.
- D. Recycled Content: A minimum of 50 percent recycled glass content.
- E. Biosoluble: As determined by research conducted by the International Agency for Research on Cancer (IARC) and supported by revised reports from the National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment. Certified by European Certification Board for Mineral Wool Products (EUCEB).
- F. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation Products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
- G. Products shall not contain, asbestos, lead, mercury, or mercury compounds if possible. Products shall be Certified UL GREENGUARD Gold or Indoor Advantage Gold.
- H. Insulation materials applied to carbon steel shall be Mass Load Corrosion Rate (MLCR) tested per ASTM 1617.

- I. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- J. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.02 FLEXIBLE GLASS FIBER INSULATION

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com.
 - 2. Johns Manville Corporation: www.jm.com.
 - 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 4. Knauf Insulation: www.knaufinsulation.com.
 - 5. Owens Corning Corp: www.owenscorning.com.
- B. Insulation: ASTM C553; flexible, noncombustible.
 - 1. K (Ksi) Value: 0.36 at 75 degrees F (0.052 at 24 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
 - 2. Maximum Service Temperature: 450 degrees F (232 degrees C).
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 1. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
 - 2. Secure with self-sealing longitudinal laps and butt strips.
 - 3. Secure with outward clinch expanding staples and vapor barrier mastic.
- D. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.
- E. Vapor Barrier Lap Adhesive: Compatible with insulation.
 - 1. Manufacturers:
- F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

1. Manufacturers:

2.03 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

- A. Manufacturers:

1. Auburn Manufacturing Inc: www.auburnmfg.com/#sle.

- B. Insulation: ASTM C553 Type V; flexible, noncombustible.

1. Comply with ASTM C1695.
2. K (Ksi) Value: 0.37 at 100 degrees F (0.053 at 38 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
3. Minimum Service Temperature: 32 degrees F (0 degrees C).
4. Maximum Service Temperature: 500 degrees F (260 degrees C).
5. Maximum Water Vapor Absorption: Less than 5.0 percent by weight.
6. Color: Green.
7. Weight: 7.65 oz/sq ft (2334.4 g/sq m).
8. Effective Thickness: 1.25 plus/minus 0.25 inch (0.032 plus/minus 0.0064 m).

2.04 WEATHER BARRIER COATINGS

- A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.

1. Manufacturers:
2. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
3. Water Vapor Permeance: Greater than 1.0 perm (57 ng/(Pa s m)) in accordance with ASTM E96/E96M.
4. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
5. Color: As selected by Architect.

2.05 JACKETING AND ACCESSORIES

- A. PVC Plastic:

1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com.
 2. Jacket: Sheet material, off-white color.
 - a. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
 - c. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch (0.25 mm).
 - e. Connections: Brush on welding adhesive.
 3. Covering Adhesive Mastic: Compatible with insulation.
- B. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
1. Lagging Adhesive: Compatible with insulation.
 - a. Manufacturers:
 - 1) Vimasco Corporation: www.vimasco.com/#sle.
- C. Aluminum Jacket:
1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch (0.41 mm) with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 2. Thickness: 0.016 inch (0.40 mm) sheet.
 3. Finish: Smooth.
 4. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 5. Fittings: 0.016 inch (0.40 mm) thick die-shaped fitting covers with factory-attached protective liner.
 6. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.
 7. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.
- D. Aluminum-Foil Laminate Jacket:

1. Manufacturers:
 - a. H.B. Fuller Construction Products, Inc: www.fosterproducts.com/#sle.
 - b. Ideal Tape Co., Inc: www.idealtape.com/#sle.
 2. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
 3. Finish: Aluminum smooth.
 4. Comply with ASTM C1775.
- E. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
1. Thickness: 0.010 inch (0.25 mm).
 2. Finish: Smooth.
 3. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.
- F. Reinforced Tape:
1. Manufacturers:
 - a. Ideal Tape Co.: www.idealtape.com/#sle.
 2. Comply with UL 723 or ASTM E84.
 3. Moisture Vapor Permeability: 0.00 perm inch (0.00 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
 4. Finish: Match insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment has been tested and defects repaired / replaced before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.

- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- F. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- G. For fiberglass insulated equipment containing fluids below ambient temperature, provide vapor barrier jackets, factory-applied or field-applied, and finish with glass cloth and vapor barrier adhesive.
- H. For hot equipment containing fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
- I. Fiberglass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- J. Inserts and Shields:
 - 1. Application: Equipment 1-1/2 inches (40 mm) diameter or larger.
 - 2. Shields: Galvanized steel between hangers and inserts.
 - 3. Insert location: Between support shield and equipment and under the finish jacket.
 - 4. Insert configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- K. Finish insulation at supports, protrusions, and interruptions.
- L. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting, PVC jacket and fitting covers, or aluminum jacket.
- M. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- N. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

END OF SECTION

SECTION 22 07 19.11
UNDER-LAVATORY PIPE AND SUPPLY COVERS - PLUMBEREX

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Under-lavatory pipe and supply covers.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: General Contractor.
- B. Section 22 10 05 - Plumbing Piping.

1.03 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. ABA Standards - ABA Accessibility Standards 2004, with Amendments (2015).
- C. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- D. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures 2011 (Reaffirmed 2022).
- E. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping 2021.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2015a.
- G. IAPMO (UPC) - Uniform Plumbing Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Provide catalog illustrations of covers, sizes, and finishes.
- B. Manufacturer's Instructions: Indicate installation methods and procedures.

- C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 UNDER-LAVATORY PIPE AND SUPPLY COVERS

- A. Manufacturers:
 - 1. Plumberex Specialty Products, Inc: www.plumberex.com/#sle.
- B. Basis of Design: Plumberex Specialty Products, Inc; www.plumberex.com/#sle.
 - 1. Fusion Molded Under-Lavatory Insulators (Non-Sewn): Plumberex Handy-Shield Maxx.
 - 2. Slim Fit Under-Lavatory Insulators (Non-Sewn): Plumberex Trap Gear.
 - 3. Under-Lavatory Covers with Snap-Lock Fasteners (Molded): Plumberex Pro-Extreme.
- C. General:
 - 1. Insulate exposed drainage piping including hot, cold, and tempered water supplies under lavatories or sinks per ADA Standards.
 - 2. Exterior Surfaces: Smooth nonabsorbent with no finger recessed indentations for easy cleaning.
 - 3. Construction: 1/8 inch (3.2 mm) PVC with antimicrobial, antifungal, and ultraviolet light (UV) resistant properties.
 - a. Comply with ASTM C1822 for covers on accessible lavatory piping.
 - b. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
 - c. Microbial and Fungal Resistance for Interior and Exterior: Comply with ASTM G21.
- D. ASTM E84 Compliant, Under-Lavatory Insulators:
 - 1. Manufacturers:

- a. Plumberex Specialty Products, Inc: Plumberex Trap Gear: www.plumberex.com/#sle.
2. Provide with weep hole for condensation drainage and ventilation.
3. Fasteners: Reusable, fusion bonded Velcro and tamper resistant snap-locking fasteners with no sharp or abrasive external surfaces. No cable tie fasteners allowed.
4. Comply with:
 - a. ASTM E84/UL 723 to comply with flame spread and smoke development rating of 25/450.
 - b. ADA Standards.
 - c. ICC (IBC).
 - d. ICC A117.1.
 - e. IAPMO (UPC).
- E. Under-Lavatory Covers with Snap-Lock Fasteners:
 1. Manufacturers:
 - a. Plumberex Specialty Products, Inc: www.plumberex.com/#sle.
 2. Construction: PVC with antimicrobial, antifungal, and UV-resistant properties, one piece injected molded design with internal bridge at top of J-bend to prevent separating.
 3. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces. No cable ties allowed.
 4. Maintenance: Valve and supply cover shall be accessible for maintenance without removal and with removable, reusable access cap.
 5. Comply with:
 - a. ASTM C1822.
 - b. ADA Standards.
 - c. ICC A117.1.
 - d. Requirement to protect against contact with sharp or abrasive surfaces.
 6. Provide with weep hole for condensation drainage and ventilation.

7. Vandal Resistance: Internal line grooves for trimming not easily torn by hand. All trim line grooves shall require tool cutting only.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that walls, floor finishes, lavatories, and piping are prepared and ready for installation of under-lavatory guards.
- B. Confirm location and size of fixtures and piping before installation.

3.02 INSTALLATION

- A. Install under-lavatory guards according to manufacturer's written instructions..

3.03 CLEANING

- A. Clean installed under-lavatory guards.
- B. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.

3.04 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 22 07 19
PLUMBING PIPING INSULATION

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Flexible elastomeric cellular insulation.
- B. Piping insulation.
- C. Flexible removable and reusable blanket insulation.
- D. Glass fiber insulation.
- E. Hydrous calcium silicate insulation.
- F. Polyethylene insulation.
- G. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 09 91 23 - Interior Painting: Painting insulation jacket.
- C. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric] 2014.
- D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2013.
- E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement 2007 (Reapproved 2013).
- F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2010.

- G. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation 2013.
- H. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2014.
- I. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2015.
- J. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013.
- K. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2013).
- L. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation 2021.
- M. ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service 2010 (Reapproved 2015).
- N. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber 2014.
- O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2015a.
- P. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2014.
- Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator 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.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS**2.01 REGULATORY REQUIREMENTS**

- A. Comply with requirements in the schedule(s), plan(s), & package accompanying this document.
- B. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723, when mounted per ASTM E 2231, 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. Formaldehyde Free: Third party certified with UL Environment Validation.
- D. Recycled Content: A minimum of 50 percent recycled glass content.
- E. Biosoluble: As determined by research conducted by the International Agency for Research on Cancer (IARC) and supported by revised reports from the National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment. Certified by European Certification Board for Mineral Wool Products (EUCEB).
- F. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation Products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
- G. Products shall not contain, asbestos, lead, mercury, or mercury compounds if possible. Products shall be Certified UL GREENGUARD Gold or Indoor Advantage Gold.

- H. Insulation materials applied to carbon steel shall be Mass Load Corrosion Rate (MLCR) tested per ASTM 1617.
- I. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- J. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.02 GLASS FIBER INSULATION

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville Corporation: www.jm.com/#sle.
 - 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
 - 5. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
 - 2. Maximum Service Temperature: 850 degrees F (454 degrees C).
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
 - 1. K (Ksi) Value: ASTM C177, 0.23 at 75 degrees F (0.034 at 24 degrees C).
 - 2. Maximum Service Temperature: 220 degrees F (104 degrees C).
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
 - 1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
 - 2. Maximum Service Temperature: 650 degrees F (343 degrees C).
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.

- E. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm (0.029 ng/(Pa s m)).
- F. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.
- G. Vapor Barrier Lap Adhesive: Compatible with insulation.
- H. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- I. Indoor Vapor Barrier Finish:
 - 1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
 - 2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.03 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

- A. Manufacturers:
 - 1. Auburn Manufacturing Inc: www.auburnmfg.com/#sle.
- B. Insulation: ASTM C553 Type V; flexible, noncombustible.
 - 1. Comply with ASTM C1695.
 - 2. K (Ksi) Value: 0.37 at 100 degrees F (0.053 at 38 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
 - 3. Minimum Service Temperature: 32 degrees F (0 degrees C).
 - 4. Maximum Service Temperature: 500 degrees F (260 degrees C).
 - 5. Maximum Water Vapor Absorption: Less than 5.0 percent by weight.
 - 6. Color: Green.
 - 7. Weight: 12.5 oz/sq ft (3814.4 g/sq m).
 - 8. Effective Thickness: 1.25 plus/minus 0.25 inch (0.032 plus/minus 0.0064 m).

2.04 HYDROUS CALCIUM SILICATE INSULATION

- A. Manufacturers:
 - 1. Johns Manville Corporation: www.jm.com.

- B. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.
 - 1. K (Ksi) Value: 0.40 at 300 degrees F (0.057 at 149 degrees C) when tested in accordance with ASTM C177 or ASTM C518.
 - 2. Maximum Service Temperature: 1,200 degrees F (649 degrees C).
 - 3. Density: 15 pcf (240 kg/cu m).
- C. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

2.05 POLYETHYLENE INSULATION

- A. Manufacturers:
 - 1. Armacell LLC: www.armacell.us.
- B. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.
 - 1. K (Ksi) Value: ASTM C177; 0.25 at 75 degrees F (0.036 at 24 degrees C).
 - 2. Maximum Service Temperature: 200 degrees F (93 degrees C).
 - 3. Density: 2 pcf (32 kg/cu m).
 - 4. Maximum Moisture Absorption: 1.0 percent by volume.
 - 5. Moisture Vapor Permeability: 0.05 perm inch (0.073 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
 - 6. Connection: Contact adhesive.

2.06 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
 - 1. Aeroflex USA, Inc: www.aeroflexusa.com.
 - 2. Armacell LLC: www.armacell.us.
 - 3. K-Flex USA LLC: www.kflexusa.com.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).

2. Maximum Service Temperature: 220 degrees F (104 degrees C).
 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.07 JACKETING AND ACCESSORIES

A. PVC Plastic Jacket:

1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com.
2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F (Minus 18 degrees C).
 - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
 - c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/(Pa s m)), maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch (0.25 mm).
 - e. Connections: Brush on welding adhesive.
3. Covering Adhesive Mastic: Compatible with insulation.

B. ABS Plastic Jacket:

1. Manufacturers:
2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - b. Maximum Service Temperature: 180 degrees F (82 degrees C).
 - c. Moisture Vapor Permeability: 0.012 perm inch (0.018 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 30 mil, 0.03 inch (0.75 mm).
 - e. Connections: Brush on welding adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested and defects repaired before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Glass wool insulated pipes conveying fluids below ambient temperature where vapor barriers are 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.
 - 5. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic
 - 6. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
 - 7. Additionally, raw ends of pipe insulation sections shall be coated with vapor retarder mastic at 12' to 21' intervals; at the Engineer's discretion, on straight piping and on either side of all fittings, flanges or valves. Vapor retarder mastic shall completely coat the ends of the pipe insulation and extend onto the bore of the pipe insulation and onto the jacketing a minimum of 2".

- E. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies and expansion joints.
- F. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.
- H. Fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- I. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- J. Inserts and Shields:
 - 1. Application: Piping 2 inches (50 mm) diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert Location: Between support shield and piping and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- K. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 84 00.

- L. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with PVC jacket and fitting covers.
- M. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- N. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil, 0.001 inch (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- O. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- P. Install insulation with self-sealing factory-applied jackets as follows:
 - 1. Locate all longitudinal pipe insulation jacketing laps in least visible location.
 - 2. Draw jacket tight and smooth.
 - 3. For proper sealing, seal lap joints with reasonable pressure being applied with a plastic squeegee or sealing tool.
 - 4. Vapor seal all circumference joints with a factory furnished matching pressure sensitive butt strips installed with reasonable pressure being applied with a plastic squeegee or sealing tool.
- Q. Cut insulation in a manner to avoid compressing insulation.
- R. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- S. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (102 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

END OF SECTION

**SECTION 22 10 05
PLUMBING PIPING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Sanitary waste piping, buried within 5 feet (1500 mm) of building.
- B. Sanitary waste piping, above grade.
- C. Domestic water piping, buried within 5 feet (1500 mm) of building.
- D. Domestic water piping, above grade.
- E. Storm drainage piping, buried within 5 feet (1500 mm) of building.
 - 1. Storm drainage piping, above grade.
 - 2. Pipe flanges, unions, and couplings.
 - 3. Pipe hangers and supports.
 - 4. Ball valves.
 - 5. Butterfly valves.
 - 6. Balancing valves.
 - 7. Check.
 - 8. Pressure reducing valves.
 - 9. Pressure relief valves.
 - 10. Strainers.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.
- C. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- D. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- E. Section 22 07 19 - Plumbing Piping Insulation.

- F. Section 33 01 10.58 - Disinfection of Water Utility Piping Systems.

1.03 REFERENCE STANDARDS

- A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems 1999, and addenda A&B (R2004).
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2012.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2013.
- D. ASME B31.9 - Building Services Piping 2014.
- E. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems 2009.
- F. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999 (Reapproved 2014).
- G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2012.
- H. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings 2015.
- I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2015.
- J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service 2015.
- K. ASTM B32 - Standard Specification for Solder Metal 2008 (Reapproved 2014).
- L. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes 2015a.
- M. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2014.
- N. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2013.
- O. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube 2010.
- P. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings 2002 (Reapproved 2010).
- Q. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings 2014.

- R. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2015a.
- S. ASTM F628 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core 2012.
- T. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing 2013a.
- U. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems 2011.
- V. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems 2010.
- W. AWWA C606 - Grooved and Shouldered Joints 2011.
- X. AWWA C651 - Disinfecting Water Mains 2005.
- Y. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications 2009.
- Z. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2011.
- AA. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements 2012.
- BB. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements 2012.
- CC. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements 2013.
- DD. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements 2013.
- EE. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2009.
- FF. MSS SP-67 - Butterfly Valves 2011.
- GG. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010.
- HH. NSF 61 - Drinking Water System Components - Health Effects 2014 (Errata 2015).
- II. NSF 372 - Drinking Water System Components - Lead Content 2011.
- JJ. PPI TR-4 - PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength

(MRS) Ratings For Thermoplastic Piping Materials or Pipe 2013.

KK. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Project Record Documents: Record actual locations of valves.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS**2.01 GENERAL REQUIREMENTS**

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

2.02 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
- C. Epoxy Coated Cast Iron Pipe: ASTM A-888& CISPI 3, extra heavy weight.
 - 1. Fittings: Epoxy coated cast iron.
 - 2. Joints: ASTM C1540, virgin elastomeric neoprene compound gasket and stainless steel band, shield, screw housing, and screws.
- D. ABS Pipe: ASTM F628.
 - 1. Fittings: ABS.
 - 2. Joints: Solvent welded with ASTM D2235 cement.
- E. CPVC Pipe: ASTM D2846/D2846M, ASTM F441/F441M, or ASTM F442/F442M.
 - 1. Manufacturers:
 - a. IPEX USA, LLC; Xirtec CPVC Schedule 40: www.ipexna.com/#sle.
 - 2. Fittings: CPVC; ASTM D2846/D2846M, ASTM F437, ASTM F438, or ASTM F439.
 - 3. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement.

2.03 SANITARY WASTE PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. Epoxy Coated Cast Iron Pipe: ASTM A-888& CISPI 3, extra heavy weight.
 - 1. Fittings: Epoxy coated cast iron.
 - 2. Joints: ASTM C1540, virgin elastomeric neoprene compound gasket and stainless steel band, shield, screw housing, and screws.
- D. ABS Pipe: ASTM F628.
 - 1. Fittings: ABS.
 - 2. Joints: Solvent welded with ASTM D2235 cement.
- E. ABS Pipe: ASTM D2661.
 - 1. Fittings: ABS.
 - 2. Joints: Solvent welded with ASTM D2235 cement.
- F. CPVC Pipe: ASTM D2846/D2846M, ASTM F441/F441M, or ASTM F442/F442M.
 - 1. Manufacturers:
 - a. IPEX USA, LLC; Xirtec CPVC Schedule 40: www.ipexna.com/#sle.
 - 2. Fittings: CPVC; ASTM D2846/D2846M, ASTM F437, ASTM F438, or ASTM F439.
 - 3. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement.
 - 4. Manufacturers:
- G. PVC Pipe: ASTM D2729.
 - 1. Fittings: PVC.

2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Copper Pipe: ASTM B42, hard drawn.
 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 2. Joints: ASTM B32, alloy Sn95 solder.
- B. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876 or ASTM F877.
 1. Manufacturers:
 - a. Uponor, Inc: www.uponorengineering.com/#sle.
 - b. Viega LLC: www.viega.us/#sle.
 2. PPI TR-4 Pressure Design Basis:
 - a. 160 psig (1102 kPa) at maximum 73 degrees F (23 degrees C).
 3. Fittings: Brass and copper.
 4. Fittings: Brass and engineered polymer (EP) ASTM F1960.
 5. Joints: Mechanical compression fittings.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B88 (ASTM B88M), Type , Drawn (H).
 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 2. Fittings: Cast iron, coated.
 3. Joints: ASTM B32, alloy Sn95 solder.
- B. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized.
 1. Manufacturers:
 - a. Wheatland Tube Company: www.wheatland.com/#sle.
 2. Threaded Joints: ASME B16.4 cast iron fittings.
 3. Grooved Joints: AWWA C606 grooved pipe, cast iron fittings, and mechanical couplings.

2.06 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 - 1. Fittings: Cast iron.
 - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. ABS Pipe: ASTM D2680.
 - 1. Fittings: ABS.
 - 2. Joints: Solvent welded with ASTM D2235 cement.
- D. PVC Pipe: ASTM D2665 or ASTM D3034.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.
- E. PVC Pipe: ASTM D2665, ASTM D3034, or ASTM F679.
 - 1. Fittings: PVC.
 - 2. Joints: Push-on, using ASTM F477 elastomeric gaskets.

2.07 STORM DRAINAGE PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 - 1. Fittings: Cast iron.
 - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. ABS Pipe: ASTM D2680.
 - 1. Fittings: ABS.

2. Joints: Solvent welded with ASTM D2235 cement.
- D. PVC Pipe: ASTM D2665.
1. Fittings: PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.08 PIPE FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 inch (80 mm, DN) and Under:
1. Ferrous Pipe: Class 150 malleable iron threaded unions.
 2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. Flanges for Pipe Sizes Over 1 inch (25 mm, DN):
1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
 2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
1. Dimensions and Testing: In accordance with AWWA C606.
 2. Housing Material: Provide ASTM A47/A47M malleable iron, ductile iron, or galvanized.
 3. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).
 4. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
 5. When pipe is field grooved, provide coupling manufacturer's grooving tools.
 6. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.
 - b. Apollo Valves: www.apollovalves.com/#sle.
 - c. Grinnell Products: www.grinnell.com/#sle.
 - d. Shurjoint Piping Products, Inc., a Tyco Business: www.shurjoint.com.

D. No-Hub Couplings:

1. Testing: In accordance with ASTM C1277 and CISPI 310.
2. Gasket Material: Neoprene complying with ASTM C564.
3. Band Material: Stainless steel.
4. Eyelet Material: Stainless steel.
5. Manufacturers:
 - a. MIFAB, Inc: www.mifab.com/#sle.

E. Shielded, Heavy Duty No-Hub Couplings:

1. Testing: In accordance with ASTM C1540 and FM 1680.
2. Gasket Material: Neoprene complying with ASTM C564.
3. Band Material: Stainless steel.
4. Eyelet Material: Stainless steel.
5. Manufacturers:
 - a. MIFAB, Inc: www.mifab.com/#sle.

F. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.**2.09 PIPE HANGERS AND SUPPORTS**

- A. See Section 22 05 29 for additional requirements.
- B. Provide hangers and supports that comply with MSS SP-58.
 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 4. Vertical Pipe Support: Steel riser clamp.
 5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.

6. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 - a. Bases: High-density polypropylene.
 - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - c. Steel Components: Stainless steel or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 - d. Attachment and Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion-resistant material.
 - e. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.
 - f. Manufacturers:
 - 1) PHP Systems/Design: www.phpsd.com/#sle.
- C. Plumbing Piping - Drain, Waste, and Vent:
1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm, DN): Malleable iron, adjustable swivel, split ring.
 2. Hangers for Pipe Sizes 2 inch (50 mm, DN) and Over: Carbon steel, adjustable, clevis.
 3. Wall Support for Pipe Sizes to 3 inch (80 mm, DN): Cast iron hook.
 4. Wall Support for Pipe Sizes 4 inch (100 mm, DN) and Over: Welded steel bracket and wrought steel clamp.
 5. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- D. Plumbing Piping - Water:
1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm, DN): Malleable iron, adjustable swivel, split ring.
 2. Hangers for Cold Pipe Sizes 2 inch (50 mm, DN) and Over: Carbon steel, adjustable, clevis.

3. Hangers for Hot Pipe Sizes 2 to 4 inch (50 to 100 mm, DN): Carbon steel, adjustable, clevis.
 4. Wall Support for Pipe Sizes Up to 3 inch (80 mm, DN): Cast iron hook.
 5. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- E. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
1. Concrete Wedge Expansion Anchors: Comply with ICC-ES AC193.
 2. Masonry Wedge Expansion Anchors: Comply with ICC-ES AC01.
 3. Concrete Screw Type Anchors: Comply with ICC-ES AC193.
 4. Masonry Screw Type Anchors: Comply with ICC-ES AC106.
 5. Concrete Adhesive Type Anchors: Comply with ICC-ES AC308.
 6. Other Types: As required.
 7. Manufacturers:
 - a. Powers Fasteners, Inc: www.powers.com/#sle.

2.10 GATE VALVES

- A. Manufacturers:
1. Conbraco Industries, Inc: www.apollovalves.com.
 2. Nibco, Inc: www.nibco.com.
 3. Milwaukee Valve Company: www.milwaukeevalve.com.

2.11 GLOBE VALVES

- A. Manufacturers:
1. Conbraco Industries, Inc: www.apollovalves.com.
 2. Nibco, Inc: www.nibco.com.
 3. Milwaukee Valve Company: www.milwaukeevalve.com.

2.12 BALL VALVES

A. Manufacturers:

1. Anvil International: www.anvilintl.com/#sle.
2. Apollo Valves: www.apollovalves.com/#sle.
3. Conbraco Industries, Inc: www.apollovalves.com.
4. Grinnell Products: www.grinnell.com/#sle.
5. Nibco, Inc: www.nibco.com/#sle.
6. SharkBite, a brand of Reliance Worldwide Corporation: www.sharkbite.com/#sle.
7. Uponor, Inc: www.uponorengineering.com/#sle.
8. Viega LLC: www.viega.us/#sle.
9. Shurjoint Piping Products, Inc., a Tyco Business: www.shurjoint.com.
10. Nibco, Inc: www.nibco.com.
11. Milwaukee Valve Company: www.milwaukeevalve.com.

- B. Construction, 4 Inches (100 mm) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder, threaded, or grooved ends with union.

2.13 BUTTERFLY VALVES

A. Manufacturers:

1. Anvil International: www.anvilintl.com/#sle.
2. Apollo Valves: www.apollovalves.com/#sle.
3. Crane Company: www.cranecpe.com/#sle.
4. Flomatic Valves: www.flomatic.com/#sle.
5. Grinnell Products, a Tyco Business: www.grinnell.com.
6. Shurjoint Piping Products, Inc., a Tyco Business: www.shurjoint.com.
7. Hammond Valve: www.hammondvalve.com.

8. Crane Co.: www.cranecpe.com.
 9. Milwaukee Valve Company: www.milwaukeevalve.com.
- B. Construction 1-1/2 inch (40 mm, DN) and Larger: MSS SP-67, 200 psi (1380 kPa) CWP, cast or ductile iron body, nickel-plated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.

2.14 BALANCING VALVES

- A. Manufacturers:
1. Anvil International: www.anvilintl.com/#sle.
 2. ITT Bell & Gossett: www.bellgossett.com/#sle.
 3. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
 4. Griswold Controls: www.griswoldcontrols.com/#sle.
 5. Taco, Inc: www.taco-hvac.com/#sle.
- B. Construction: Class 125, brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet or blowdown/backflush drain.
- C. Manual Operated Y-Pattern Globe, Size 1/2 to 2 inch (15 to 50 mm, DN):
1. Class 125, brass or bronze body, multi-turn handwheel, memory stop, variable orifice, soldered connections, dual PT (hot and cold pressure-temperature) test ports for 300 psi (2,068 kPa), minus 4 to 250 deg F (minus 20 to 121.1 deg C) WOG service.
- D. Calibration: Control flow within five percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi (24 kPa).

2.15 FLOW-BALANCING VALVES

- A. Manufacturers:
1. Anvil International: www.anvilintl.com/#sle.
 2. Griswold Controls: www.griswoldcontrols.com/#sle.
 3. ITT Bell & Gossett: www.bellgossett.com/#sle.
 4. Taco, Inc: www.taco-hvac.com/#sle.

- B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet or blowdown/backflush drain.
- C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi (24 kPa).

2.16 PIPING SPECIALTIES

- A. Flow Controls:

2.17 FLOW CONTROLS

- A. Manufacturers:
 - 1. ITT Bell & Gossett: www.bellgossett.com.
 - 2. Griswold Controls: www.griswoldcontrols.com.
 - 3. Taco, Inc: www.taco-hvac.com.

2.18 SWING CHECK VALVES

- A. Manufacturers:
 - 1. Hammond Valve: www.hammondvalve.com.
 - 2. Nibco, Inc: www.nibco.com.
 - 3. Milwaukee Valve Company: www.milwaukeevalve.com.

2.19 SPRING LOADED CHECK VALVES

- A. Manufacturers:
 - 1. Hammond Valve: www.hammondvalve.com.
 - 2. Crane Co.: www.cranecpe.com.
 - 3. Milwaukee Valve Company: www.milwaukeevalve.com.

2.20 PRESSURE RELIEF VALVES

- A. Manufacturers:
 - 1. Cla-Val Co: www.cla-val.com/#sle.
 - 2. Watts Regulator Company: www.wattsregulator.com/#sle.

- B. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
- C. Surge Anticipating, Pressure Relief Valves:
 - 1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 - 2. Size: As indicated on drawings; 1/2 to 40 inch (15 to 1,000 mm, DN).
 - 3. Class 150 flange ends; AWWA C550 compliant cast iron globe valve with elastomeric diaphragm, seat disc, and epoxy coated finish both internally and externally.
 - 4. Differential Pressure Based Dual Pilot-Operator:
 - a. Low-Surge Operating Range: 7 to 50 psi (0.48 to 3.5 bar).
 - b. High-Surge Operating Range: 10 to 80 psi (0.7 to 5.5 bar).
 - c. Connected into brass, bronze, or stainless steel pilot piping and fittings.
 - d. Precision fixed-flow restrictor, test needle-valve, strainer, swing check valve, pressure gauges, and isolation valves.
- D. Pressure:
- E. Temperature and Pressure:

2.21 CONTROL AND SERVICE VALVES

- A. Flow Metered Valves:
 - 1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 - 2. Cast iron globe valve, elastomeric diaphragm, seat disc, flow insertion probe, and epoxy coated both internally and externally.
 - 3. Pre-Inserted Flow Probe:
 - a. Fluid Service Rating: Up to 250 psi (1,724 kPa).
 - b. Electromagnetic, plus or minus two percent NIST traceable accuracy.
- B. Flow Control Valves:

1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 2. Size: 1/2 to 40 inch (15 to 1,000 mm, DN), Class 150 flange ends.
 3. AWWA C550 compliant cast iron globe valve, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
 4. Differential Pressure Based Rate-of-Flow Pilot-Operator:
 - a. Operating Range: 25 to 50 psi (1.72 to 3.4 Bar).
 - b. Connected into brass, bronze, or copper pilot piping and fittings.
 - c. Precision fixed-flow restrictor, strainer, pressure gauges, and isolation valves.
- C. Level Control Valves:
1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 2. Size: 3 to 40 inch (80 to 1,000 mm, DN) ends.
 3. AWWA C550 compliant 2-position operated, cast iron globe valve, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.
 4. Pressure Based Rate-of-Flow Pilot-Operator:
 - a. Connected into brass, copper, ductile iron, or stainless steel pilot piping and fittings.
 - b. Fixed-flow restrictor, check valve, strainer, altitude gauge, and isolation valves.
 - c. Spring Operating Range: 10 to 60 ft (3 to 18 m) with 1 to 3 ft (0.3 to 0.9 m) reservoir head to supply pressure differential.
- D. Pump Control Valves:
1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalue.com/#sle.
 2. Size: 2 to 20 inch (50 to 500 mm, DN), Class 150 flange ends.
 3. AWWA C550 compliant, single chamber, cast iron globe valve, elastomeric diaphragm, seat disc and epoxy coated both internally and externally.

4. Valve Pilot-Operator:
 - a. Watertight components connected into brass or ductile iron pilot piping and fittings.
 - b. Control: NEMA 250 Type 4X 120 VAC, 50/60 Hz solenoid valve.
 - c. Monitoring: NEMA 250 Type 4X single-pole double-throw limit switch.
 - d. Fixed-flow restrictor, check valve, needle valve, strainer, pressure gauges, and isolation valves.
- E. Electronic Control Valves:
 1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalve.com/#sle.
 2. Size: 2 to 20 inch (50 to 500 mm, DN), Class 150 flange ends.
- F. Pilot and Needle Valves:
 1. Manufacturers:
 - a. Singer, a Mueller brand: www.singervalve.com/#sle.
 2. 5 to 50 psi (0.35 to 35 Bar) Pilot-Operator: Bronze body, 5 to 50 psi (0.35 to 35 Bar), top spring adjusting screw.
 3. Needle Valve: Brass body, stainless steel stem with maximum service rating of 400 psi (27.6 Bar) at 140 degrees F (60 degrees C).

2.22 STRAINERS

- A. Manufacturers:
 1. Armstrong International, Inc: www.armstronginternational.com/#sle.
 2. Green Country Filter Manufacturing: www.greencountryfilter.com/#sle.
 3. Jomar Valves, a division of Jomar Group: www.jomarvalve.com/#sle.
 4. WEAMCO: www.weamco.com/#sle.
- B. Size 1/2 inch (15 mm, DN) to 3 inch (80 mm, DN):
 1. Class 150, threaded forged bronze Y-pattern body, stainless steel perforated mesh screen with cap, and rated for 150 psi (1,034 kPa), 250 deg F (121.1 deg C) WOG service.

- C. Size 2 inch (50 mm, DN) and Smaller:
 - 1. Threaded brass body for 175 psi (1200 kPa) CWP, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
 - 2. Class 150, threaded bronze body 300 psi (2070 kPa) CWP, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
- D. Size 1-1/2 inch (40 mm, DN) to 4 inch (100 mm, DN):
 - 1. Class 125, flanged iron body, Y pattern with 1/16 inch (1.6 mm) stainless steel perforated screen.

2.23 RELIEF VALVES

- A. Pressure Relief:
 - 1. Manufacturers:
 - a. Cla-Val Co: www.cla-val.com.
 - b. Henry Technologies: www.henrytech.com.
 - c. Watts Regulator Company: www.wattsregulator.com.
- B. Temperature and Pressure Relief:
 - 1. Manufacturers:
 - a. Cla-Val Co: www.cla-val.com.
 - b. Henry Technologies: www.henrytech.com.
 - c. Watts Regulator Company: www.wattsregulator.com.

2.24 STRAINERS

- A. Manufacturers:
 - 1. Armstrong International, Inc: www.armstronginternational.com.
 - 2. Green Country Filter Manufacturing: www.greencountryfilter.com.
 - 3. WEAMCO: www.weamco.com.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 22 05 16.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
 - 1. See Section 22 07 19.
- H. Provide access where valves and fittings are not exposed.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- J. Provide support for utility meters in accordance with requirements of utility companies.
- K. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.
 - 1. See Section 09 91 23 for painting of interior plumbing systems and components.
 - 2. See Section 09 91 13 for painting of exterior plumbing systems and components.

- L. Excavate in accordance with Section 31 23 16.
- M. Backfill in accordance with Section 31 23 23.
- N. Install bell and spigot pipe with bell end upstream.
- O. Install valves with stems upright or horizontal, not inverted. See Section 22 05 23.
- P. Install water piping to ASME B31.9.
- Q. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- R. Sleeve pipes passing through partitions, walls, and floors.
- S. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm, DN).
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- T. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Support horizontal piping as indicated.
 - 3. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
 - 5. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.

7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Provide hangers adjacent to motor-driven equipment with vibration isolation; see Section 22 05 48.
10. Support cast iron drainage piping at every joint.

3.04 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install globe valves for throttling, bypass, or manual flow control services.
- F. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
- G. Provide spring-loaded check valves on discharge of water pumps.
- H. Provide flow controls in water recirculating systems where indicated.

3.05 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch (10 mm) vertically of location indicated and slope to drain at minimum of 1/4 inch per foot (1:50) slope.
- B. Water Piping: Slope at minimum of 1/32 inch per foot (1:400) and arrange to drain at low points.

3.06 FIELD TESTS AND INSPECTIONS

- A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.
- B. Domestic Water Systems:
 1. Perform hydrostatic testing for leakage prior to system disinfection.
 2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
 3. General:

- a. Fill the system with water and raise static head to 10 psi (345 kPa) above service pressure. Minimum static head of 50 to 150 psi (345 to 1,034 kPa). As an exception, certain codes allow a maximum static pressure of 80 psi (551.6 kPa).
- C. Test Results: Document and certify successful results, otherwise repair, document, and retest.

3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfect water distribution system in accordance with Section 33 01 10.58.
- B. Prior to starting work, verify system is complete, flushed, and clean.
- C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- D. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.
- E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- F. Maintain disinfectant in system for 24 hours.
- G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.08 SERVICE CONNECTIONS

- A. Provide new sanitary and storm sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves pressure reducing valve.
 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Caulk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

2. Provide 18 gauge, 0.0478-inch (1.21 mm) galvanized sheet metal sleeve around service main to 6 inch (150 mm) above floor and 6 feet (1800 mm) minimum below grade. Size for minimum of 2 inches (50 mm) of loose batt insulation stuffing.

END OF SECTION

**SECTION 22 30 00
PLUMBING EQUIPMENT****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Water heaters.
- B. In-line circulator pumps.

1.02 RELATED REQUIREMENTS

- A. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NSF 61 - Drinking Water System Components - Health Effects 2014 (Errata 2015).
- C. UL 778 - Standard for Motor-Operated Water Pumps Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Indicate pump type, capacity, power requirements.
 - 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

4. Provide electrical characteristics and connection requirements.
- C. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- E. Project Record Documents: Record actual locations of components.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Certifications:
 1. Water Heaters: NSF approved.
 2. Electric Water Heaters: UL listed and labeled to UL 174.
 3. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.
- D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.01 WATER HEATERS

- A. Manufacturers:

1. A.O. Smith Water Products Co: www.hotwater.com/#sle.
 2. Bock Water Heaters, Inc: www.bockwaterheaters.com/#sle.
 3. Rheem Manufacturing Company: www.rheem.com/#sle.
- B. Commercial Electric Water Heaters:
1. Type: Factory-assembled and wired, electric, vertical storage.
 2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
 3. Accessories:
 - a. Water Connections: Brass.
 - b. Dip Tube: Brass.
 - c. Drain valve.
 - d. Anode: Magnesium.
 - e. Temperature and Pressure Relief Valve: ASME labeled.
 4. Controls: Ventilated control cabinet, factory-wired with solid state progressive sequencing step controller, fuses, magnetic contactors, control transformer, pilot lights indicating main power and heating steps, control circuit toggle switch, electronic low-water (probe-type) cut-off, high temperature limit thermostat, flush-mounted temperature and pressure gauges.
 5. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in (11.6 W/sq m).

2.02 IN-LINE CIRCULATOR PUMPS

- A. Manufacturers:
1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.
 2. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
 3. Sterling SIHI GmbH: www.sterlingsihi.com/#sle.
- B. Casing: Bronze, rated for 125 psig (860 kPa) working pressure, with stainless steel rotor assembly.
- C. Impeller: Bronze.

- D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- E. Seal: Carbon rotating against a stationary ceramic seat.
- F. Drive: Flexible coupling.

2.03 CONDENSATE REMOVAL PUMPS

- A. Manufacturers:
 - 1. Refco "Gobi II: www.refcoswiss.com/en-us/produkte/condensate-pump~p13582
 - 2. Substitutions: Bluediamond Maxiblu: www.bluediamondpumps.com
- B. Construction: Diaphragm type,
- C. Safety: UL 778.
- D. Performance:
 - 1. Flow: 11 gph, at 65.6 feet max head.
 - 2. Noise level: <19 dB.
 - 3. Electrical Characteristics:
 - a. (8 W) during Maximum operation at 110V.
 - b. Powered from indoor Fan Coil unit.

2.04 ELECTRICAL WORK

- A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring.
- B. Electrical characteristics to be as specified or indicated.
- C. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.
- D. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related electrical work to achieve operating system.

3.02 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front-end interface; see Section 25 1500.

END OF SECTION

**SECTION 22 40 00
PLUMBING FIXTURES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Tank type water closets.
- B. Lavatories.
- C. Sinks.
- D. Under-lavatory pipe supply covers.
- E. Indoor drinking fountains.
- F. Bottle filling drinking fountains.
- G. Mop sinks.

1.02 RELATED REQUIREMENTS

- A. Section 12 36 00 - Countertops: Counters for sinks and lavatories.
- B. Section 22 10 05 - Plumbing Piping.
- C. Section 22 10 06 - Plumbing Piping Specialties.
- D. Section 22 30 00 - Plumbing Equipment.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ASME A112.18.1 - Plumbing Supply Fittings 2012.
- C. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures 2011 (Reaffirmed 2022).
- D. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices 2020.
- E. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping 2021.
- F. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- G. NSF 61 - Drinking Water System Components - Health Effects 2014 (Errata 2015).

- H. NSF 372 - Drinking Water System Components - Lead Content 2011.
- I. UL (DIR) - Online Certifications Directory current listings at database.ul.com.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 REGULATORY REQUIREMENTS

- A. Comply with applicable codes for installation of plumbing systems.
- B. Comply with UL (DIR) requirements.
- C. Perform work in accordance with local health department regulations.
- D. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

2.03 TANK TYPE WATER CLOSETS

- A. Manufacturers:
 - 1. American Standard, Inc: www.americanstandard-us.com/#sle.
 - 2. Western Pottery: www.westernpottery.com.
 - 3. Gerber Plumbing Fixtures LLC: www.gerberonline.com/#sle.
 - 4. Kohler Company: www.kohler.com/#sle.
 - 5. Mansfield Plumbing Products: www.mansfieldplumbing.com/#sle.

6. PROFLO: www.ferguson.com/#sle.
 7. Sloan Valve: www.sloanvalve.com/#sle.
 8. Viega LLC: www.viega.us/#sle.
 9. Zurn Industries, LLC: www.zurn.com/#sle.
- B. Floor-Mounted Bowl:
1. ASME A112.19.2; siphon jet, vitreous china, 17.25 inches (438 mm) high, close-coupled closet combination with elongated rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps, vandal proof cover locking device.
 2. Water Consumption: 1.28 gal (4.8 L) per flush, maximum.
 3. Trapway Outlet: 3 inch (80 mm, DN).
- C. Bowl: ASME A112.19.2; wall hung, vitreous china, reverse trap, whirlpool action close-coupled closet combination with regular rim, insulated vitreous china closet tank with fittings and lever flushing valve, chrome-plated bolt caps.
- D. Toilet Seats:
1. Plastic: Solid, white, elongated, closed front, hinged seat cover, slow-closing hinged seat cover, and brass bolts with covers.
 2. Manufacturers:
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Bemis Manufacturing Company: www.bemismfg.com/#sle.
 - c. DXV by American Standard, Inc: www.dxv.com/#sle.
 - d. PROFLO: www.ferguson.com/#sle.

2.04 LAVATORIES

- A. Manufacturers:
1. American Standard, Inc: www.americanstandard-us.com/#sle.
 2. Kohler Company: www.kohler.com/#sle.
 3. Zurn Industries, LLC: www.zurn.com/#sle.
- B. Wall-Hung Bathroom Sink:

1. Vitreous China: ASME A112.19.2; white, rectangular basin with splash lip, front overflow, soap depression, and hanger. Size 19 by 17 inch as indicated on drawings with 4 inch (100 mm) centerset spacing.
 2. Products:
 - a. PROFLO Commercial - 19 x 17, Rectangular: www.ferguson.com/#sle.
 3. Carrier:
 - a. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger bearing plate and studs.
 - b. Manufacturers:
 - 1) Jay R. Smith MFG. Co: www.jrsmith.com/#sle.
 - 2) JOSAM Company: www.josam.com/#sle.
- C. Supply Faucet:
1. Manufacturers:
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Grohe America, Inc: www.grohe.com/us/#sle.
 - c. Kohler Company: www.kohler.com/#sle.
 - d. PROFLO: www.ferguson.com/#sle.
 - e. Zurn Industries, LLC: www.zurn.com/#sle.
 2. ASME A112.18.1; chrome plated combination supply fitting with pop-up waste water economy aerator with maximum flow of 0.5 gpm.
 3. Touchless, Supply Faucet: ASME A112.18.1; deck-mount, ceramic cartridge disc valve, pop-up drain and maximum flow of 0.5 gpm, low-flow (1.9 Lpm, low-flow). Polished Chrome finish.
 4. Mixing Valve: Leonard 270-LF.
 5. Water Supply: 3/8 inch (9 mm) compression connections.
- D. Thermostatic Mixing Valve:

1. ASSE 1070 listed with combination stop, strainer, and check valves, and flexible stainless steel connectors.
 2. Manufacturers:
 - a. Leonard: www.leonardvalve.com.
 - b. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com/#sle.
 3. Slip-joint P-trap.
 4. Braided hot and cold water supply lines.
 5. Chrome plated 17 gauge, 0.0538 inch (1.37 mm) brass P-trap with clean-out plug and arm with escutcheon.
- E. Lavatory Carrier:
1. Manufacturers:
 - a. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - b. JOSAM Company: www.josam.com/#sle.
 - c. Zurn Industries, LLC: www.zurn.com/#sle.
 2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall

2.05 SINKS

- A. Manufacturers:
1. American Bath Group: www.americanbathgroup.com/#sle.
 2. American Standard, Inc: www.americanstandard-us.com/#sle.
 3. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 4. Kohler Company: www.kohler.com/#sle.
 5. Meganite, Inc: www.meganite.com/#sle.
 6. Relang International, LLC: www.duraseinusa.com/#sle.
 7. Elkay: www.elkay.com.
- B. Single Compartment Bowl

1. ASME A112.19.3; 17 by 21 inch outside dimensions 20 gauge, 0.0359 inch (0.91 mm) thick, Type 304; stainless steel, self rimming and undercoated, with ledge back drilled for trim.
 2. Drain: 1-1/2 inch (38 mm); chromed brass.
- C. Kitchen Faucets:
1. Manufacturers:
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Grohe America, Inc: www.grohe.com/us/#sle.
 - c. PROFLO: www.ferguson.com/#sle.
 - d. Cleveland: www.cfgonline.com
 2. Single Handle Faucet with Three-Function Pulldown Spray Head:
 - a. Type: Deck-mount, high arc faucet with mounting plate.
 - b. Spray Functions: Stream, full spray and pause at 1.75 gpm (6.62 Lpm), maximum.
 - c. ASME A112.18.1, ADA Standards, and NSF 61 compliant assembly.
 - d. Materials: Ceramic disc-cartridge valve on brass body with polished chrome finish.
 - e. Products:
 - 1) PROFLO: www.ferguson.com/#sle.
- D. Accessories: Provide braided water supply lines, slip-joint p-trap, and stainless steel basket strainer.

2.06 UNDER-LAVATORY PIPE SUPPLY COVERS

- A. Manufacturers:
1. Plumberex Specialty Products, Inc: www.plumberex.com/#sle.
- B. Basis of Design: Plumberex Specialty Products, Inc; www.plumberex.com/#sle.
1. Fusion Molded Under-Lavatory Insulators (Non-Sewn): Plumberex Handy-Shield Maxx.
 2. Slim Fit Under-Lavatory Insulators (Non-Sewn): Plumberex Trap Gear.
 3. Under-Lavatory Covers with Snap-Lock Fasteners (Molded): Plumberex Pro-Extreme.

C. General:

1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
2. Construction: 1/8 inch (3.2 mm) PVC with antimicrobial, antifungal and UV resistant properties.
 - a. Comply with ASTM C1822 Type I for covers on accessible lavatory piping.
 - b. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
 - c. Comply with ICC A117.1.
 - d. Thermal Resistance: R value of 0.504 or lower when tested by ASTM C177.
 - e. Thermal Conductivity: K value of 0.358 or density of 21.61 pcf per ASTM C518.
 - f. Microbial and Fungal Resistance for Interior and Exterior: Comply with ASTM G21.
3. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces. No cable ties allowed.

2.07 INDOOR DRINKING FOUNTAINS**A. Manufacturers:**

1. Elkay Manufacturing Company: www.elkay.com/#sle.
2. Halsey Taylor: www.halseytaylor.com/#sle.
3. Haws Corporation: www.hawscor.com/#sle.
4. Murdock Manufacturing, Inc: www.murdockmfg.com/#sle.

2.08 BOTTLE FILLING DRINKING FOUNTAINS**A. Manufacturers:**

1. Elkay Manufacturing Company: www.elkay.com/#sle.
2. Murdock Manufacturing, Inc: www.murdockmfg.com/#sle.

B. Bottle Filler: Materials to match fountain.**2.09 MOP SINKS****A. Manufacturers:**

1. Acorn Engineering Company: www.acorneng.com/#sle.
 2. Mustee: www.mustee.com.
 3. Just Manufacturing Company: www.justmfg.com/#sle.
 4. Metcraft Industries, Inc: metcraftindustries.com/#sle.
 5. Zurn Industries, LLC: www.zurn.com/#sle.
- B. Material: High resistance fiberglass.
- C. Grid Strainer: Stainless steel; integral; removable.
- D. Dimensions: As indicated on drawings.
- E. Accessories:
1. Hose clamp hanger.
 2. Mop hanger.

2.10 HOSE BIB BOXES

- A. Manufacturers:
1. Metcraft Industries, Inc: metcraftindustries.com/#sle.
 2. Woodford Manufacturing Co: www.woodfordmfg.com/woodford.
- B. Material: stainless steel.
- C. Finish: As indicated.
- D. Mount in wall fully recessed.
- E. Provide with two-valve supply.
- F. Provide with internal hose drain bracket and waste outlet.
- G. Provide with concealed hinge door and cam cylinder lock keyed alike.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.

3.02 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome-plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall carriers and bolts.
- E. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

- A. Clean plumbing fixtures and equipment.
- B. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.07 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Do not permit use of fixtures by construction personnel.
- C. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL**1.01 SUMMARY**

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Fastener systems.
 - 5. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
 - 3. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
 - 4. Division 23 Sections "Metal Ducts" and "Nonmetal Ducts" for duct hangers and supports.
 - 5. Division 23 Section "HVAC Insulation" for pipe saddles at pipe hangers.

1.02 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.03 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Fiberglass pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Fiberglass strut systems. Include Product Data for components.
 - 4. Equipment supports.
- C. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel", AWS D1.3, "Structural Welding Code--Sheet Steel", AWS D1.4, "Structural Welding Code-- Reinforcing Steel", ASME Boiler and Pressure Vessel Code: Section IX as required.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 5. ASME Boiler and Pressure Vessel Code: Section IX.

- C. Pipe hangers and supports shall conform to the recommendations of ASHRAE, ASPE, ANSI, and MSS, unless otherwise indicated.
- D. Ensure anchors are acceptable per ICC for use in cracked concrete.

PART 2 - PRODUCTS

2.01 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. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.
 - 8. Grinnell Corp.
 - 9. GS Metals Corp.
 - 10. National Pipe Hanger Corporation.
 - 11. PHD Manufacturing, Inc.
 - 12. PHS Industries, Inc.
 - 13. Piping Technology & Products, Inc.
 - 14. 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.

2.02 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.

2.03 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.

2.04 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 or threaded-anchor-type zinc-coated or stainless 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.

2.05 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.
- 1. Available Manufacturers:
 - a. Pate.
 - b. Thy Curb.
 - c. Models:
 - 1) TEMS-1 for insulated roof decks.
 - 2) TEMS-2 for un-insulated and existing roof decks.
 - 3) TEMS-3 for single-ply roof systems.
 - 2. Equipment supports shall be all welded 18 gauge galvanized steel shell, baseplate and counterflashing with internal bulkhead re-enforcement and wood nailer.

2.06 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 (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including, but not limited to proper placement of inserts, anchors and other building structural attachments.

3.02 HANGER AND SUPPORT APPLICATIONS

- A. Use only one type hangers and supports, by one manufacturer, for each piping service.
- B. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- C. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- D. Use galvanized steel, painted, or cadmium plated components in hangers and supports unless otherwise indicated.
- E. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing or provide copper-plated hangers and supports for copper piping systems where hangers are in contact with bare pipe.
- F. Use padded hangers for piping that is subject to scratching.
- G. Horizontal-Piping Hangers and Supports: Select size of hangers and supports to exactly fit pipe size for bare piping, and around piping insulation with saddle or shield for insulated piping. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN 20 to DN 600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 3. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.

4. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8 (DN 20 to DN 200).
 5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
 6. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
 7. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN 15 to DN 50).
 8. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8 (DN 10 to DN 200).
 9. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3 (DN 10 to DN 80).
 10. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 11. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN 25 to DN 750), from 2 rods if longitudinal movement caused by expansion and contraction might occur.
- H. Vertical-Piping Clamps: Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.
- I. Hanger-Rod Attachments: Select size of hanger rod attachments to suit hanger rods. 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 (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) 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 (49 to 232 deg C) piping installations.
- J. Building Attachments: Select size of building attachments to suit hanger rods. 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-joint 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 (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).

- c. Heavy (MSS Type 33): 3000 lb (1360 kg).
- 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.
- K. 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.
- L. Spring Hangers and Supports: Select spring hangers and supports to suit pipe size and loading. 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 (32 mm).
 - 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 absorb 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 absorb 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 absorb 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.
- M. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.03 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-58 and MSS SP-69 for construction standards and applications. Install hangers, supports, clamps, and attachments as required by the following table to properly support piping from building structure.

1	7	3/8	--	--
1-1/4	8	3/8	--	--
1-1/2	9	3/8	--	--
2	10	3/8	--	--

- 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 fabricated from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
 - 3. Neither wire nor perforated metal shall be used to support piping, unless otherwise indicated or approved.

4. Do not support piping from other piping, unless otherwise indicated.
- 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 (100 mm) 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. 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. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. 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.
- L. Insulated Piping: Comply with the following:
 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

- c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
- 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
- 3. High compressive-strength inserts may permit use of shorter shields or shields with less arc span. Edit first subparagraph and associated subparagraph below to suit Project.
- 4. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

5. Pipe Size (in)	Shield Length (in)	Minimum Gauge
1/2 to 1-1/2	4	26
2 to 6	6	20

- 5. Shield Dimensions for Pipe: Not less than the following:
- 6. Insert Material: Length at least as long as protective shield.
- 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.04 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.

3.05 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports, as required, unless otherwise indicated.
- 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. Obtain fusion without undercut or overlap.
 - 2. Remove welding flux immediately.
 - 3. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.06 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 inch (25 mm).

3.07 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 (0.05 mm).
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL**1.01 RELATED DOCUMENTS**

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

1.02 SUMMARY

- A. Section Includes:
1. Elastomeric isolation pads.
 2. Elastomeric isolation mounts.
 3. Restrained elastomeric isolation mounts.
 4. Open-spring isolators.
 5. Housed-spring isolators.
 6. Restrained-spring isolators.
 7. Housed-restrained-spring isolators.
 8. Pipe-riser resilient supports.
 9. Resilient pipe guides.
 10. Air-spring isolators.
 11. Restrained-air-spring isolators.
 12. Elastomeric hangers.
 13. Spring hangers.
 14. Snubbers.
 15. Restraint channel bracings.
 16. Restraint cables.
 17. Seismic-restraint accessories.

18. Mechanical anchor bolts.
19. Adhesive anchor bolts.
20. Vibration isolation equipment bases.
21. Restrained isolation roof-curb rails.

1.03 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
 1. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria,

and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic and wind forces required to select vibration isolators and seismic and wind restraints and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer.
- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.
- E. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For restrained-air-spring mounts to include in operation and maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 PRODUCTS

2.01 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. CADDY; brand of nVent Electrical plc.
 - c. California Dynamics Corporation.
 - d. Isolation Technology, Inc.
 - e. Kinetics Noise Control, Inc.
 - f. Mason Industries, Inc.
 - g. Vibration Isolation.
 - h. Vibration Management Corp.
 - i. Vibration Mountings & Controls, Inc.
 - 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 3. Size: Factory or field cut to match requirements of supported equipment.
 - 4. Pad Material: Oil and water resistant with elastomeric properties.
 - 5. Surface Pattern: Smooth pattern.

6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient and elastomeric.
 - a. Surface Pattern: Smooth pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.02 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. CADDY; brand of nVent Electrical plc.
 - c. California Dynamics Corporation.
 - d. Isolation Technology, Inc.
 - e. Vibration Eliminator Co., Inc.
 - f. Vibration Isolation.
 - g. Vibration Mountings & Controls, Inc.
2. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.03 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

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

- a. Ace Mountings Co., Inc.
 - b. CADDY; brand of nVent Electrical plc.
 - c. California Dynamics Corporation.
 - d. Isolation Technology, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Isolation.
 - g. Vibration Management Corp.
 - h. Vibration Mountings & Controls, Inc.
2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
- a. Housing: Cast-ductile iron or welded steel.
 - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.04 OPEN-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators: .
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. CADDY; brand of nVent Electrical plc.
 - c. California Dynamics Corporation.
 - d. Isolation Technology, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Management Corp.

- i. Vibration Mountings & Controls, Inc.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.05 RESTRAINT CABLES

- A. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.06 SEISMIC-RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to restraint cables.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.07 ADHESIVE ANCHOR BOLTS

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

1. Cooper B-line; brand of Eaton, Electrical Sector.
 2. Hilti, Inc.
 3. Mason Industries, Inc.
 4. Powers Fasteners.
 5. Simpson Strong-Tie Co., Inc.
- B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.08 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CADDY; brand of nVent Electrical plc.
 2. California Dynamics Corporation.
 3. Kinetics Noise Control, Inc.
 4. Mason Industries, Inc.
 5. Novia; A Division of C&P.
 6. Vibration Eliminator Co., Inc.
 7. Vibration Isolation.
 8. Vibration Management Corp.
 9. Vibration Mountings & Controls, Inc.
- B. Steel Rails: Factory-fabricated, welded, structural-steel rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
 - a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- B. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

B. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.**D. Attachment to Structure:** If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.**E. Drilled-in Anchors:**

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. **Wedge Anchors:** Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. **Adhesive Anchors:** Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
 - 9. Test and adjust restrained-air-spring isolator controls and safeties.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.06 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.

- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL**1.01 RELATED DOCUMENTS**

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Valve tags.
 - 6. Warning tags.

1.03 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.

1.04 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

2.01 EQUIPMENT LABELS

- A. 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.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 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.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 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 inches high.

2.04 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Fiberboard or metal.
 - 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.

3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.05 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

3.01 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.

3.02 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

- A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
 1. Identification Paint: Use for contrasting background.
 2. Stencil Paint: Use for pipe marking.
- 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.

3.04 DUCT LABEL INSTALLATION

- A. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.05 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL**1.01 RELATED DOCUMENTS**

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - 2. Testing, adjusting, and balancing existing systems and equipment.
 - 3. Sound tests.
 - 4. Vibration tests.
 - 5. Duct leakage tests.
 - 6. Control system verification.

1.03 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TABB: Testing, Adjusting, and Balancing Bureau.
- F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- G. TDH: Total dynamic head.

1.04 PREINSTALLATION MEETINGS

- A. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Needs for coordination and cooperation of trades and subcontractors.
 - d. Proposed procedures for documentation and communication flow.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
 1. Instrument type and make.
 2. Serial number.
 3. Application.
 4. Dates of use.
 5. Dates of calibration.

1.06 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC, NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC NEBB or TABB.
 2. TAB Technician: Employee of the TAB specialist and certified by AABC NEBB or TABB as a TAB technician.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

1.07 FIELD 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.

1.08 P2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

2.01 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one of the following available TAB specialists that may be engaged include, but are not limited to, the following:
1. Neudorfer Engineers, Seattle, Wa
 2. Airtest Co., Mountlake Terrace, Wa
 3. Hardin & Sons, Edgewood, Wa

2.02 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.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

- C. Examine the approved submittals for HVAC systems and equipment.
- 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 ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. 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.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.

- P. 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.

2.03 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' startup is complete and safeties are verified.
 - g. Automatic temperature-control systems are operational.
 - h. Ceilings are installed.
 - i. Windows and doors are installed.
 - j. Suitable access to balancing devices and equipment is provided.
- C. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" ASHRAE 111 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

- D. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish.
- E. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- F. Take and report testing and balancing measurements in inch-pound (IP) units.

2.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check 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 outdoor-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. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

2.05 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 total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 4. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 5. 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 occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
 - 1. Measure airflow of submain and branch ducts.
 - 2. Adjust submain and branch duct volume dampers for specified airflow.
 - 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
 - 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 - 2. Measure inlets and outlets airflow.
 - 3. Adjust each inlet and outlet for specified airflow.
 - 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
 - 1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
 - 2. Re-measure and confirm that total airflow is within design.
 - 3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
 - 4. Mark all final settings.
 - 5. Test system in economizer mode. Verify proper operation and adjust if necessary.
 - 6. Measure and record all operating data.
 - 7. Record final fan-performance data.

2.06 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Phase and hertz.

5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter size and thermal-protection-element rating.
 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

2.07 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record fan and motor operating data.

2.08 DUCT LEAKAGE TESTS

- A. Witness the duct pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified tolerances.
- C. Report deficiencies observed.

2.09 CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
 1. Verify temperature control system is operating within the design limitations.
 2. Confirm that the sequences of operation are in compliance with Contract Documents.
 3. Verify that controllers are calibrated and function as intended.
 4. Verify that controller set points are as indicated.
 5. Verify the operation of lockout or interlock systems.
 6. Verify the operation of valve and damper actuators.
 7. Verify that controlled devices are properly installed and connected to correct controller.
 8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.

9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

2.10 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 2. Air Outlets and Inlets: Plus or minus 10 percent.
 3. Heating-Water Flow Rate: Plus or minus 10 percent.
 4. Cooling-Water Flow Rate: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

2.11 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.

2. Name and address of the TAB specialist.
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 supervisor 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's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, 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. Other system operating conditions that affect performance.

- D. 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 outdoor, 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.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches.
 - i. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.

3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg .
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg .
 - e. Filter static-pressure differential in inches wg .
 - f. Outdoor airflow in cfm.
 - g. Return airflow in cfm.
 - h. Outdoor-air damper position.
 - i. Return-air damper position.
- F. Instrument Calibration Reports:
 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.
- G. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
- H. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- I. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

- J. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- K. If TAB work fails, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
 - 3. If the second verification also fails, Owner may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- L. Prepare test and inspection reports.

2.12 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB 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 TAB during near-peak summer and winter conditions.

END OF SECTION

**SECTION 23 07 13
DUCT INSULATION****PART 1 GENERAL****1.01 RELATED DOCUMENTS**

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

1.02 SUMMARY

- A. Section includes insulating the following duct services:
 - 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, Type I, commercial, kitchen hood exhaust.
 - 6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
 - 7. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 8. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

1.03 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 insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.04 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.

1.05 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.

1.06 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.

1.07 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.08 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.

1.09 P2 PRODUCTS**1.10 INSULATION MATERIALS**

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum 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. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA.
 - b. Armacell LLC.
 - c. K-Flex USA.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Section 016000 "Product Requirements."

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Certainteed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.

- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Certainteed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.

- I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armacell LLC.
 - b. Nomaco.

1.11 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA.
 - b. Armacell LLC.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. K-Flex USA.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. P.I.C. Plastics, Inc.
 - c. Speedline Corporation.

1.12 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Knauf Insulation.
 - d. Vimasco Corporation.
 - 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 - 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.

1.13 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B.. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
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.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
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.

1.14 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.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

1.15 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 - c. Knauf Insulation.
 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 - c. Knauf Insulation.

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. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ideal Tape Co., Inc., an American Biltrite Company.
 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 - c. Knauf Insulation.
 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.

1.16 SECUREMENTS

A. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Midwest Fasteners, Inc.
 - 4) Nelson Stud Welding.
2. 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.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Gemco.
 - 2) Midwest Fasteners, Inc.

1.17 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.

1.18 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

1.19 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. 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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. 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. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches
 - 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 at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. 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.

1.20 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 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.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):
Install insulation continuously through walls and partitions.

1.21 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.

1.22 INSTALLATION OF MINERAL-FIBER INSULATION

- 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 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one 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 two times the insulation thickness, but not less than 3 inches
 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- 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 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

- b. On duct sides with dimensions larger than 18 inches space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one 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 two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

1.23 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:

1. Inspect ductwork, 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 one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

1.24 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, Type I, commercial, kitchen hood exhaust.
 6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
 7. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 8. 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.

1.25 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 2 inches thick
 - 3. Mineral-Fiber Board: 2 inches
 - 4. Polyolefin: 1 inch thick.

- B. Concealed, round and flat-oval, return-air duct insulation shall be one of the following:
 - 1. Retain one or more of four subparagraphs below.
 - 2. Flexible Elastomeric: 1 inch thick.
 - 3. Mineral-Fiber Blanket: 2 inches thick
 - 4. Mineral-Fiber Board: 2 inches thick
 - 5. Polyolefin: 1 inch thick.

- C. Concealed, rectangular, supply-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 2 inches thick
 - 3. Mineral-Fiber Board: 2 inches thick
 - 4. Polyolefin: 1 inch thick.

- D. Concealed, rectangular, return-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 2 inches thick
 - 3. Mineral-Fiber Board: 2 inches thick
 - 4. Polyolefin: 1 inch thick.

- E. Concealed, rectangular, outdoor-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 2 inches thick

3. Mineral-Fiber Board: 2 inches thick
 4. Polyolefin: 1 inch thick.
- F. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
 2. Mineral-Fiber Blanket: 2 inches thick
 3. Mineral-Fiber Board: 2 inches thick
 4. Polyolefin: 1 inch thick.
- G. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

END OF SECTION

**SECTION 23 08 00
COMMISSIONING OF HVAC****PART 1 GENERAL****1.01 RELATED DOCUMENTS**

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

1.02 SUMMARY

- A. Section includes commissioning process requirements for the following HVAC&R systems, assemblies, and equipment:
 - 1. Energy supply systems, including gas supply.
 - 2. Cooling generation systems, including direct-expansion systems.
 - 3. Distribution systems, including air distribution (heating and cooling) systems exhaust systems air-handling units.
 - 4. Terminal and packaged units, including unit heaters fan-coil units electric heating packaged units.
 - 5. Vibration and sound systems, including sound attenuation vibration isolation devices seismic restraints.
 - 6. Controls and instrumentation, including BAS.
 - 7. Systems testing and balancing verification, including domestic hot-water circulating systems supply-air systems return-air systems exhaust-air systems.
 - 8. VRF system
- B. Related Requirements:
 - 1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements and Commissioning Coordinator responsibilities.

1.03 DEFINITIONS

- A. BAS: Building automation system.
- B. DDC: Direct digital controls.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

- D. "Systems," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- E. TAB: Testing, adjusting, and balancing.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For BAS and HVAC&R Testing Technician.
- B. Construction Checklists: See related Sections for technical requirements for the following construction checklists:
 - 1. Vibration and seismic controls for HVAC&R piping and equipment.
 - 2. Instrumentation and control for HVAC&R.
 - 3. Refrigerant piping.
 - 4. Metal ducts and accessories.
 - 5. Fans.
 - 6. Particulate air filtration.
 - 7. Air-handling units.

1.05 QUALITY ASSURANCE

- A. BAS Testing Technician Qualifications: Technicians to perform BAS construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:
 - 1. Journey-level or equivalent skill level with knowledge of BAS, HVAC&R, electrical concepts, and building operations.
 - 2. Minimum three years experience installing, servicing, and operating systems manufactured by approved manufacturer.
 - 3. International Society of Automation (ISA) Certified Control Systems Technician (CCST) Level I.
- B. HVAC&R Testing Technician Qualifications: Technicians to perform HVAC&R construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:

1. Journey-level or equivalent skill level. Vocational School four-year program graduate or an Associates degree in mechanical systems, air conditioning, or similar field. Degree may be offset by three years' experience in servicing mechanical systems in the HVAC industry. Generally, required knowledge includes HVAC&R systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of HVAC&R equipment, assemblies, and systems.
 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
 3. One of the following:
 - a. National Environmental Balancing Bureau (NEBB) Certified Testing, Adjusting, and Balancing Technician.
 - b. Associated Air Balance Council (AABC) Certified Test and Balance Technician.
 - c. Owner retains the right to waive NEBB or AABC Certification.
- C. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform HVAC&R commissioning work, perform the following:
1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:
 - a. Equipment/instrument identification number.
 - b. Planned commissioning application or use.
 - c. Manufacturer, make, model, and serial number.
 - d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
 2. Test equipment and instrumentation shall meet the following criteria:
 - a. Capable of testing and measuring performance within the specified acceptance criteria.
 - b. Be calibrated at the manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
 - c. Be maintained in good repair and operating condition throughout the duration of use on this Project.
 - d. Be recalibrated/repared if dropped or damaged in any way since last calibrated.

D. Proprietary Test Instrumentation and Tools:

1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the commissioning process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:
 - a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:
 - 1) Instrument or tool identification number.
 - 2) Equipment schedule designation of equipment for which the instrument or tool is required.
 - 3) Manufacturer, make, model, and serial number.
 - 4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.
 - b. Include a separate list of proprietary test instrumentation and tools in the operation and maintenance manuals.
 - c. HVAC&R proprietary test instrumentation and tools become the property of Owner at the time of Substantial Completion.

PART 2 PRODUCTS (NOT USED)**PART 3 EXECUTION****3.01 GENERAL TESTING REQUIREMENTS**

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents and approved Shop Drawings and submittals.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.
- C. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (e.g., normal shutdown, normal auto position, normal manual

position, unoccupied cycle, emergency power, and alarm conditions).

- E. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.
- F. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.
- G. Construction Checklists: Prepare and submit detailed construction checklists for HVAC&R systems, subsystems, equipment, and components.
 - 1. Contributors to the development of construction checklists shall include, but are not limited to, the following:
 - a. HVAC&R systems and equipment installers.
 - b. TAB technicians.
 - c. HVAC&R instrumentation and controls installers.
- H. Perform tests using design conditions, whenever possible.
 - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by Commissioning Coordinator and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
 - 2. Commissioning test procedures may direct that set points be altered when simulating conditions is impractical.
 - 3. Commissioning test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.
- J. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

- K. Coordinate schedule with, and perform the following activities at the direction of, Commissioning Coordinator.
- L. Comply with construction checklist requirements, including material verification, installation checks, start-up, and performance tests requirements specified in Sections specifying HVAC systems and equipment.
- M. Provide technicians, instrumentation, tools, and equipment to complete and document the following:
 - 1. Performance tests.
 - 2. Demonstration of a sample of performance tests.
 - 3. Commissioning tests.
 - 4. Commissioning test demonstrations.

3.02 TAB COMMISSIONING TESTS

- A. TAB Verification:
 - 1. Prerequisites: Completion of "Examination" Article requirements and correction of deficiencies, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
 - 2. Completion of "Preparation" Article requirements for preparation of a TAB plan that includes strategies and step-by-step procedures, and system-readiness checks and reports, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
 - 3. Scope: HVAC&R air systems and hydronic piping systems.
 - 4. Purpose: Differential flow relationships intended to maintain air pressurization differentials between the various areas of Project.
 - 5. Conditions of the Test:
 - a. Commissioning Test Demonstration Sampling Rate: As specified in "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
 - b. Systems operating in full heating mode with minimum outside-air volume.
 - c. Systems operating in full cooling mode with minimum outside-air volume.
 - d. For measurements at air-handling units with economizer controls; systems operating in economizer mode with 100 percent outside air.
 - 6. Acceptance Criteria:

- a. Additionally, no rechecked measurement shall differ from measurements documented in the final report by more than two times the tolerances allowed.
- b. Under all conditions, where the Contract Documents indicate a differential in airflow between supply and exhaust and/or return in a space, the differential relationship shall be maintained.

END OF SECTION

**SECTION 23 09 23.12
CONTROL DAMPERS****PART 1 GENERAL****1.01 RELATED DOCUMENTS**

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

1.02 SUMMARY

- A. Section includes the following types of control dampers and actuators for DDC systems:
 - 1. Rectangular control dampers.
 - 2. Round control dampers.
 - 3. General control-damper actuator requirements.
 - 4. Electric and electronic actuators.
- B. Related Requirements:
 - 1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.03 DEFINITIONS

- A. DDC: Direct-digital control.
- B. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
 - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

3. Product description with complete technical data, performance curves, and product specification sheets.
 4. Installation instructions, including factors affecting performance.
- B. Shop Drawings:
1. Include plans, elevations, sections, and mounting details.
 2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
 4. Include diagrams for air and process signal tubing.
 5. Include diagrams for pneumatic signal and main air tubing.
- C. Delegated-Design Submittal:
1. Schedule and design calculations for control dampers and actuators, including the following.
 - a. Flow at project design and minimum flow conditions.
 - b. Face velocity at project design and minimum airflow conditions.
 - c. Pressure drop across damper at project design and minimum airflow conditions.
 - d. AMCA 500D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
 - e. Maximum close-off pressure.
 - f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
 - g. Torque required at worst case condition for sizing actuator.
 - h. Actuator selection indicating torque provided.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plan drawings and corresponding product installation 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. Product installation location shown in relationship to room, duct, and equipment.
2. Size and location of wall access panels for control dampers and actuators installed behind walls.
3. Size and location of ceiling access panels for control dampers and actuators installed above inaccessible ceilings.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For control dampers to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- 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. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.
- C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to size products where indicated as delegated design.
- D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.
- E. Backup Power Source: Systems and equipment served by a backup power source shall have associated control damper actuators served from a backup power source.
- F. Environmental Conditions:
 1. Provide electric control-damper actuators, with protective enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Electric control-damper actuators not available with integral enclosures, complying with requirements indicated, shall be housed in protective secondary enclosures.
 - a. Hazardous Locations: Explosion-proof rating for condition.
- G. Selection Criteria:
 1. Fail positions unless otherwise indicated:
 - a. Supply Air: Last position.
 - b. Return Air: Last position.

- c. Outdoor Air: Last position.
 - d. Mixed Air: Last position.
 - e. Exhaust Air: Last position.
2. Dampers shall have stable operation throughout full range of operation, from design to minimum airflow over varying pressures and temperatures encountered.
 3. Two-position dampers shall be full size of duct or equipment connection unless otherwise indicated.
 4. Pneumatic, two-position control dampers shall provide a smooth opening and closing characteristic slow enough to avoid excessive pressure. Dampers with pneumatic actuators shall have an adjustable opening time (valve full closed to full open) and an adjustable closing time (valve full open to full closed) ranging from zero to 10 seconds. Opening and closing times shall be independently adjustable.
 5. Control-damper, pneumatic-control signal shall not exceed 200 feet. For longer distances, provide an electric/electronic control signal to the damper and an electric solenoid valve or electro-pneumatic transducer at the damper to convert the control signal to pneumatic.

2.02 RECTANGULAR CONTROL DAMPERS

A. General Requirements:

1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.
2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.
3. Damper actuator shall be factory installed by damper manufacturer as integral part of damper assembly. Coordinate actuator location and mounting requirements with damper manufacturer.

B. Rectangular Dampers with Aluminum Airfoil Blades:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrow United Industries.
 - b. Ruskin Company.

2. Performance:
 - a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
 - b. Pressure Drop: 0.05-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
 - c. Velocity: Up to 6000 fpm
 - d. Temperature: Minus 40 to plus 185 deg F
 - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
 - f. Damper shall have AMCA seal for both air leakage and air performance.
3. Construction:
 - a. Frame:
 - 1) Material: ASTM B 211, Alloy 6063 T5 extruded-aluminum profiles, 0.07 inch thick.
 - 2) Hat-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch
 - 3) Width not less than 5 inches
 - b. Blades:
 - 1) Hollow, airfoil, extruded aluminum.
 - 2) Parallel or opposed blade configuration as required by application.
 - 3) Material: ASTM B 211, Alloy 6063 T5 aluminum, 0.07 inch thick.
 - 4) Width not to exceed 6 inches
 - 5) Length as required by close-off pressure, not to exceed 48 inches
 - c. Seals:
 - 1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
 - 2) Jambs: Stainless steel, compression type.

- d. Axles: 0.5-inch- diameter plated or stainless steel, mechanically attached to blades.
- e. Bearings:
 - 1) Molded synthetic or stainless-steel sleeve mounted in frame.
 - 2) Where blade axles are installed in vertical position, provide thrust bearings.
- f. Linkage:
 - 1) Concealed in frame.
 - 2) Constructed of aluminum and plated or stainless steel.
 - 3) Hardware: Stainless steel.
- g. Transition:
 - 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
 - 2) Factory mount damper in a sleeve with a close transition to mate to field connection.
 - 3) Damper size and sleeve shall be connection size plus 2 inches
 - 4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
 - 5) Sleeve material shall match adjacent duct.
- h. Additional Corrosion Protection for Corrosive Environments:
 - 1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch thick.
 - 2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

2.03 ELECTRIC AND ELECTRONIC ACTUATORS

- A. Type: Motor operated, with or without gears, electric and electronic.
- B. Voltage:
 - 1. Voltage selection is delegated to professional designing control system 24 V.

2. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
 3. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.
- C. Construction:
1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
 2. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.
 3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.
- D. Field Adjustment:
1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
 2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.
- E. Two-Position Actuators: Single direction, spring return or reversing type.
- F. Modulating Actuators:
1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
 2. Control Input Signal:
 - a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position, and other input drives actuator to close position. No signal of either input remains in last position.
 - b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 2- to 10-V dc and 4- to 20-mA signals.
 - c. Pulse Width Modulation (PWM): Actuator drives to a specified position according to a pulse duration (length) of signal from a dry-contact closure, triac sink or source controller.
 - d. Programmable Multi-Function:

- 1) Control input, position feedback, and running time shall be factory or field programmable.
- 2) Diagnostic feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
- 3) Service data, including at a minimum, number of hours powered and number of hours in motion.

G. Position Feedback:

1. Where indicated, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
2. Where indicated, equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

H. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

I. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

J. Damper Attachment:

1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.

3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.
- K. Temperature and Humidity:
1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
 2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.
- L. Enclosure:
1. Suitable for ambient conditions encountered by application.
 2. NEMA 250, Type 2 for indoor and protected applications.
 3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
 4. Provide actuator enclosure with a heater and controller where required by application.
- M. Stroke Time:
1. Operate damper from fully closed to fully open within 15 seconds.
 2. Operate damper from fully open to fully closed within 15 seconds.
 3. Move damper to failed position within 15 seconds.
 4. Select operating speed to be compatible with equipment and system operation.
 5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.
- N. Sound:
1. Spring Return: 62 dBA.
 2. Non-Spring Return: 45 dBA.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine roughing-in for dampers and instruments installed in duct systems to verify actual locations of connections before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CONTROL-DAMPER APPLICATIONS

- A. Control Dampers:
- B. Select from damper types indicated in "Control Dampers" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
 - 1. Rectangular Exhaust Air Duct Applications with SMACNA Construction Class 1 and Velocities to 1500 FPM: Rectangular dampers with aluminum airfoil blades.
 - 2. Round Exhaust Air Duct Applications with SMACNA Construction Class 1 and Velocities to 1500: Rectangular dampers with aluminum airfoil blades.
 - 3. Rectangular Outdoor Air Duct Applications with SMACNA Construction Class 1 and Velocities to 500 FPM Rectangular dampers with aluminum airfoil blades.
 - 4. Round Outdoor Air Duct Applications with SMACNA Construction Class 1 and Velocities to 500 FPM: Round dampers, sleeve type Round dampers, flange type.

3.03 INSTALLATION, GENERAL

- A. Furnish and install products required to satisfy most stringent requirements indicated.
- B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.
- C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- D. Seal penetrations made in fire-rated and acoustically rated assemblies.
- E. Fastening Hardware:
 - 1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.

2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.04 ELECTRIC POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.05 CONTROL DAMPERS

- A. Install smooth transitions, not exceeding 30 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.
- B. Clearance:
 1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
 2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.
- C. Service Access:
 1. Dampers and actuators shall be accessible for visual inspection and service.
 2. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 233300 "Air Duct Accessories."
- D. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory

support alone cannot handle loading.

- E. Attach actuator(s) to damper drive shaft.
- F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

3.06 CONNECTIONS

- A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.07 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.08 CHECKOUT PROCEDURES

- A. Control-Damper Checkout:
 1. Check installed products before continuity tests, leak tests, and calibration.
 2. Check dampers for proper location and accessibility.
 3. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.
 4. For pneumatic products, verify air supply for each product is properly installed.
 5. For pneumatic dampers, verify that pressure gages are provided in each air line to damper actuator and positioner.
 6. Verify that control dampers are installed correctly for flow direction.
 7. Verify that proper blade alignment, either parallel or opposed, has been provided.
 8. Verify that damper frame attachment is properly secured and sealed.
 9. Verify that damper actuator and linkage attachment are secure.
 10. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
 11. Verify that damper blade travel is unobstructed.

3.09 ADJUSTMENT, CALIBRATION, AND TESTING:

- A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.
- B. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressure.
- C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
- D. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Ductwork and accessories for HVAC including the following:
 - 1. Supply air, return air, outside air, exhaust, and relief systems.
- B. Definitions:
 - 1. SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible.
 - 2. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
 - 3. Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
 - 4. Exposed Duct: Exposed to view in a finished room.

1.02 RELATED WORK

- A. Fire Stopping Material: Section 078400, FIRESTOPPING.
- B. Seismic Reinforcing: Section 130541, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- C. General Mechanical Requirements: Section 230511, COMMON WORK RESULTS FOR HVAC.
- D. Air Terminal Units: Section 233600, AIR TERMINAL UNITS.
- E. Air Filters and Filters' Efficiencies: Section 234000, HVAC AIR CLEANING DEVICES.
- F. Testing and Balancing of Air Flows: Section 230593, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- G. G. Fireplace "B" vent: Section 23 31 00-1.

1.03 QUALITY ASSURANCE

- A. Refer to article, QUALITY ASSURANCE, in Section 230511, COMMON WORK RESULTS FOR HVAC.

- B. Fire Safety Code: Comply with NFPA 90A.
- C. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.
- D. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown on the drawings.
- E. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.

1.04 SUBMITTALS

- A. Submit in accordance with Section 230511 - COMMON WORK RESULTS FOR HVAC and Division 01 Requirements.
- B. Manufacturer's Literature and Data:
 - 1. Rectangular ducts:
 - a. Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, sealing, gage and reinforcement.
 - b. Insulation.
 - c. Sealants and gaskets.
 - d. Access doors.
 - 2. Round and flat oval duct construction details:
 - a. Manufacturer's details for duct fittings.
 - b. Insulation.
 - c. Sealants and gaskets.
 - d. Access sections.
 - e. Installation instructions.
 - 3. Volume dampers, back draft dampers.
 - 4. Upper hanger attachments.

5. Fire dampers, fire doors, and smoke dampers with installation instructions.
 6. Sound attenuators, including pressure drop and acoustic performance.
 7. Flexible ducts and clamps, with manufacturer's installation instructions.
 8. Flexible connections.
 9. Instrument test fittings.
 10. Details and design analysis of alternate or optional duct systems.
- C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 230511, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

1.05 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Moving and Conditioning Association (AMCA):
1. 500D-98Laboratory Method of Testing Dampers for Rating
 2. 500L-99.....Laboratory Method of Testing Louvers for Rating
- C. American Society of Civil Engineers (ASCE):
1. ASCE7-98Minimum Design Loads for Buildings and Other Structures
- D. American Society for Testing and Materials (ASTM):
1. A167-99Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
 2. A653-01Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip process
 3. A1011-02Standard Specification for Steel Sheet and Strip Hot rolled Carbon structural, High-Strength Low- Alloy and High Strength Low-Alloy with Improved Formability
 4. B209-01.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 5. C1071-00.....Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)

6. E84-01.....Standard Test Method for Surface Burning Characteristics of Building Materials
- E. National Fire Protection Association (NFPA):
1. 90A-2009Standard for the Installation of Air Conditioning and Ventilating Systems
- F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
1. 3rd Edition - 2005HVAC Duct Construction Standards, Metal and Flexible
 2. 1st Edition, 1985HVAC Air Duct Leakage Test Manual
- G. Underwriters Laboratories, Inc. (UL):
1. 33-93UL Standard for Safety Heat Responsive Links for Fire Protection Service
 2. 181-96UL Standard for Safety Factory-Made Air Ducts and Connectors
 3. 555-02Fire Dampers
 4. 555S-02Smoke Dampers

PART 2 - PRODUCTS

2.01 DUCT MATERIALS AND SEALANTS

- A. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A527, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.
- B. Specified Corrosion Resistant Systems: Stainless steel sheet, ASTM A167, Class 302 or 304, Condition A (annealed) Finish No. 4 for exposed ducts and Finish No. 2B for concealed duct or ducts located in mechanical rooms.
- C. Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards, paragraph S1.9.
1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.

2. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
 3. Gaskets in Flanged Joints: Soft neoprene.
- D. Approved factory made joints such as DUCTMATE SYSTEM may be used.

2.02 DUCT CONSTRUCTION AND INSTALLATION

- A. Follow SMACNA HVAC Duct Construction Standards.
- B. Duct Pressure Class:
1. 4 inch W.G. for all supply air ductwork upstream of Hot Water Coils/VAV boxes with an equivalent diameter greater than 20".
 2. 3 inch W.G. for all supply air ductwork upstream of Hot Water Coils/VAV boxes with an equivalent diameter less than 20".
 3. 2 inch W.G. for all supply air ductwork downstream of Hot Water Coils/VAV boxes.
 4. 2 inch W.G. for all return air ductwork
- C. Seal Class:
1. Seal Class A for all supply air ductwork upstream of Hot Water Coils/VAV boxes.
 2. Seal Class B for all supply air ductwork downstream of Hot Water Coils/VAV boxes.
 3. Seal Class B for all return air ductwork
 4. Seal Class A for all exhaust ductwork
- D. Duct for Negative Pressure Up to 3 inch W.G.:
1. Round Duct: Galvanized steel, spiral lock seam construction with standard slip joints.
 2. Rectangular Duct: Galvanized steel, minimum 20 gage, Pittsburgh lock seam, companion angle joints 1-1/4 by 1/8 inch minimum at not more than 8 feet spacing. DUCTMATE SYSTEM or equal manufactured joints are acceptable in lieu of companion angles.
- E. Round and Flat Oval Ducts: Furnish duct and fittings made by the same manufacturer to insure good fit of slip joints. When submitted and approved in advance, round and flat oval duct, with size converted on the basis of equal pressure drop, may be furnished in lieu of rectangular duct design shown on the drawings.

1. Elbows: Diameters 3 through 8 inches shall be two sections die stamped, all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.
 2. Provide bell mouth, conical tees or taps, laterals, reducers, and other low loss fittings as shown in SMACNA HVAC Duct Construction Standards.
 3. Ribbed Duct Option: Lighter gage round/oval duct and fittings may be furnished provided certified tests indicating that the rigidity and performance is equivalent to SMACNA standard gage ducts are submitted.
 - a. Ducts: Manufacturer's published standard gage, G90 coating, spiral lock seam construction with an intermediate standing rib.
 - b. Fittings: May be manufacturer's standard as shown in published catalogs, fabricated by spot welding and bonding with neoprene base cement or machine formed seam in lieu of continuous welded seams.
 4. Provide flat side reinforcement of oval ducts as recommended by the manufacturer and SMACNA HVAC Duct Construction Standard S3.13. Because of high pressure loss, do not use internal tie-rod reinforcement unless approved by the Engineer.
- F. Casings and Plenums: Construct in accordance with SMACNA HVAC Duct Construction Standards Section 6, including curbs, access doors, pipe penetrations, eliminators and drain pans. Access doors shall be hollow metal, insulated, with latches and door pulls, 20 inches wide by 48 - 54 inches high. Provide view port in the doors where shown. Provide drain for outside air louver plenum. Outside air plenum shall have exterior insulation. Drain piping shall be routed to the nearest floor drain.
- G. Volume Dampers: Single blade or opposed blade, multi-louver type as detailed in SMACNA Standards. Refer to SMACNA Detail Figure 2-12 for Single Blade and Figure 2.13 for Multi-blade Volume Dampers.
- H. Duct Hangers and Supports: Refer to SMACNA Standards Section IV. Avoid use of trapeze hangers for round duct.

2.03 DUCT LINER

- A. Duct liner will not be permitted. Any exceptions to this require the explicit prior approval in writing of both the Owner and the Engineer.

2.04 DUCT ACCESS DOORS, PANELS AND SECTIONS

- A. Provide access doors, sized and located for maintenance work, upstream, in the following locations:
 - 1. Each duct mounted coil.
 - 2. Each fire damper (for link service), smoke damper and automatic control damper.
 - 3. Each duct mounted smoke detector.
 - 4. For cleaning operating/procedure room supply air duct, locate access doors at 20 feet intervals and at each change in duct direction.
- B. Openings shall be as large as feasible in small ducts, 12 inch by 12 inch minimum where possible. Access sections in insulated ducts shall be double-wall, insulated. Transparent shatterproof covers are preferred for uninsulated ducts.
 - 1. For rectangular ducts: Refer to SMACNA HVAC Duct Construction Standards (Figure 2-12).
 - 2. For round and flat oval duct: Refer to SMACNA HVAC duct Construction Standards (Figure 2-11).

2.05 FIRE DAMPERS

- A. Galvanized steel, interlocking blade type, UL listing and label, 1-1/2 hour rating, 160 degrees F, Actuated Damper, 100 percent free opening with no part of the blade stack or damper frame in the air stream.
- B. Fire dampers in wet air exhaust shall be of stainless steel construction, all others may be galvanized steel.
 - 1. The damper frame may be of design and length as to function as the mounting sleeve, thus eliminating the need for a separate sleeve, as allowed by UL 555. Otherwise provide sleeves and mounting angles, minimum 14 gage, required to provide installation equivalent to the damper manufacturer's UL test installation.
 - 2. Submit manufacturer's installation instructions conforming to UL rating test.

2.06 SMOKE DAMPERS

- A. Maximum air velocity, through free area of open damper, and pressure loss: Low pressure and medium pressure duct (supply, return, exhaust, outside air): 1500 fpm. Maximum static pressure loss: 0.13 inch W.G.

- B. Maximum air leakage, closed damper: 4.0 CFM per square foot at 3 inch W.G. differential pressure.
- C. Minimum requirements for dampers:
 - 1. Shall comply with requirements of Table 6-1 of UL 555S, except for the Fire Endurance and Hose Stream Test.
 - 2. Frame: Galvanized steel channel with side, top and bottom stops or seals.
 - 3. Blades: Galvanized steel, parallel type preferably, 12 inch maximum width, edges sealed with neoprene, rubber or felt, if required to meet minimum leakage. Airfoil (streamlined) type for minimum noise generation and pressure drop are preferred for duct mounted dampers.
 - 4. Shafts: Galvanized steel.
 - 5. Bearings: Nylon, bronze sleeve or ball type.
 - 6. Hardware: Zinc plated.
 - 7. Operation: Automatic open/close. No smoke damper that requires manual reset or link replacement after actuation is acceptable. See drawings for required control operation.
- D. Motor operator (actuator): Provide electric as required by the automatic control system, externally mounted on stand-offs to allow complete insulation coverage.

2.07 COMBINATION FIRE AND SMOKE DAMPERS

- A. Combination fire and smoke dampers: Multi blade type units meeting all requirements of both fire dampers and smoke dampers shall be used where shown and may be used at the Contractor's option where applicable.

2.08 FIRE DOORS

- A. Galvanized steel, interlocking blade type, UL listing and label, 160 degrees F, Electric Fusible Link, 3 hour rating and approved for openings in Class A fire walls with rating up to 4 hours, 100 percent free opening with no part of the blade stack or damper frame in the air stream.

2.09 FLEXIBLE AIR DUCT CONNECTORS

- A. General: Factory fabricated, complying with NFPA 90A for connectors not passing through floors of buildings. Flexible ducts shall not penetrate any fire or smoke barrier which is required to have a fire resistance rating of one hour or more. Flexible duct length shall not exceed 4 feet. Provide insulated acoustical air duct connectors in supply air duct systems and elsewhere as shown.

- B. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181. Ducts larger than 8 inches in diameter shall be Class 1. Ducts 8 inches in diameter and smaller may be Class 1 or Class 2.
- C. Insulated Flexible Air Duct: Factory made including mineral fiber insulation with maximum C factor of 0.25 at 75 degrees F mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units. Acoustic insertion loss shall not be less than 3 dB per foot of straight duct, at 500 Hz, based on 6 inch duct, of 2500 fpm.
- D. Application Criteria:
 - 1. Temperature range: 0 to 200 degrees F internal.
 - 2. Maximum working velocity: 4000 feet per minute.
 - 3. Minimum working pressure, inches of water gage: 10 inches positive, 2 inches negative.
- E. Duct Clamps: 100 percent nylon strap, 175 pounds minimum loop tensile strength manufactured for this purpose or stainless steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

2.10 FLEXIBLE CONNECTIONS

- A. Where duct connections are made to fans and air handling units, install a non-combustible flexible connection of 29 ounce neoprene coated fiberglass fabric approximately 6 inches wide. For connections exposed to sun and weather provide hypalon coating in lieu of neoprene. Burning characteristics shall conform to NFPA 90A. Securely fasten flexible connections to round ducts with stainless steel or zinc-coated iron draw bands with worm gear fastener. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 2 inches on center. Fabric shall not be stressed other than by air pressure. Allow at least one inch slack to insure that no vibration is transmitted.

2.11 PREFABRICATED ROOF CURBS

- A. Galvanized steel or extruded aluminum 300 mm (12 inches) above finish roof service, continuous welded corner seams, treated wood nailer, 40 mm (1 1/2 inch) thick, 48 kg/cubic meter (3 pound/cubic feet) density rigid mineral fiberboard insulation with metal liner, built in cant strip (except for gypsum or tectum decks). For surface insulated roof deck, provide raised cant strip (recessed mounting flange) to start at the upper surface of the insulation. Curbs shall be constructed for pitched roof or ridge mounting as required to keep top of curb level.

2.12 FIRESTOPPING MATERIAL

- A. Refer to Section 078400, FIRESTOPPING.

2.13 SEISMIC RESTRAINT FOR DUCTWORK

- A. Refer to Section 130541, SEISMIC RESTRAINT REQUIREMENTS FOR NON- STRUCTURAL COMPONENTS.

2.14 INSTRUMENT TEST FITTINGS

- A. Manufactured type with a minimum two inch length for insulated duct, and a minimum one inch length for duct not insulated. Test hole shall have a flat gasket for rectangular ducts and a concave gasket for round ducts at the base, and a screw cap to prevent air leakage.
- B. Provide instrument test holes at each duct or casing mounted temperature sensor or transmitter, and at entering and leaving side of each heating coil, and fan terminal unit.

PART 3 EXECUTION**3.01 INSTALLATION**

- A. Comply with provisions of Section 230511, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.
- B. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:
 - 1. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the owner. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
 - 2. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
 - 3. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA Standards.

4. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.
- C. Install duct hangers and supports in accordance with SMACNA Standards, Chapter 4.
- D. Install fire dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test.
- E. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.
- F. Flexible duct installation: Refer to SMACNA Standards, Chapter 3. Ducts shall be continuous, single pieces not over 5 feet long (NFPA 90A), as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with clamps as recommended by SMACNA. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hour. Support ducts SMACNA Standards.
- G. Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.
- H. Control Damper Installation:
 1. Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
 2. Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
 3. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.
 4. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.
- I. Air Flow Measuring Devices (AFMD): Install units with minimum straight run distances, upstream and downstream as recommended by the manufacturer.
- J. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by the Engineer. Protect equipment and ducts during

construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

3.02 DUCT SEALING AND LEAK TESTING

- A. All ductwork shall be sealed and inspected prior to being enclosed in a shaft or covered in other inaccessible areas.
- B. All ductwork sealed to Class A requirements shall be inspected and will not require leak testing if results of the inspection is approved by the owner's representative.
- C. All ductwork to be tested shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.
- D. All tests shall be performed in the presence of the Owner's representative and the Test and Balance agency. The Test and Balance agency shall measure and record duct leakage and report to the Engineer and identify leakage source with excessive leakage.
- E. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the Engineer.
- F. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.
- G. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

3.03 TESTING, ADJUSTING AND BALANCING (TAB)

- A. Refer to Section 230593, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.04 OPERATING AND PERFORMANCE TESTS

- A. Refer to Section 230511, COMMON WORK RESULTS FOR HVAC

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Control dampers.
 - 3. Turning vanes.
 - 4. Flexible connectors.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Wiring Diagrams: For power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.06 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.

PART 2 PRODUCTS**2.01 ASSEMBLY DESCRIPTION**

- 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 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.

2.02 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221 Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches

2.03 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aire Technologies, Inc.; a DMI company.
 - b. American Warming and Ventilating; a Mestek Architectural Group company.
 - c. McGill AirFlow LLC.
 - d. Nailor Industries Inc.
 - e. Pottorff.
 - f. Ruskin Company.
 - g. Safe Air - Dowco Products.
 - h. United Enertech.
 - i. Vent Products Co., Inc.
 2. Low leakage rating, with linkage outside airstream.
 3. Suitable for horizontal or vertical applications.
 4. Frames:
 - a. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.

- d. Galvanized-steel, 0.064 inch thick.
 6. Blade Axles: Galvanized steel Nonferrous metal.
 7. Bearings:
 - a. Molded synthetic.
 - 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. Low-Leakage, Steel, Manual Volume Dampers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Warming and Ventilating; a Mestek Architectural Group company.
 - b. McGill AirFlow LLC.
 - c. Nailor Industries Inc.
 - d. Pottorff.
 - e. Safe Air - Dowco Products.
 - f. United Enertech.
 - g. Vent Products Co., Inc.
 2. Comply with AMCA 500-D testing for damper rating.
 3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 4. Suitable for horizontal or vertical applications.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized, roll-formed steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:
 - a. Molded synthetic.
 - 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. Blade Seals: Neoprene.
9. Jamb Seals: Cambered aluminum.
10. Tie Bars and Brackets: Galvanized steel.
11. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.

2.04 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. American Warming and Ventilating; a Mestek Architectural Group company.
 2. Arrow United Industries.
 3. Cesco Products; a division of MESTEK, Inc.
 4. Greenheck Fan Corporation.
 5. Lloyd Industries, Inc.
 6. McGill AirFlow LLC.
 7. Metal Form Manufacturing, Inc.
 8. Nailor Industries Inc.
 9. NCA Manufacturing, Inc.
 10. Pottorff.
 11. Ruskin Company.
 12. Safe Air - Dowco Products.

- B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Blades:
 - 1. Multiple blade with maximum blades.
 - 2. Parallel- and opposed-blade design.
 - 3. Galvanized-steel or Aluminum.0.064 inch thick single skin or 0.0747-inch- thick dual skin.
 - 4. Blade Edging: Closed-cell neoprene.
 - 5. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- D. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
 - 1. Operating Temperature Range: From minus 40 to plus 200 deg F.

2.05 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aero-Dyne Sound Control Co.
 - 2. CL WARD & Family Inc.
 - 3. Ductmate Industries, Inc; a DMI company.
 - 4. Duro Dyne Inc.
 - 5. Elgen Manufacturing.
 - 6. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Manufactured 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. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vaness and Vane Runners," and 4-4, "Vane Support in Elbows."
- E. Vane Construction: Single wall.
- F. Vane Construction: Single wall for ducts up to 48 inches

2.06 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CL WARD & Family Inc.
 - 2. Ductmate Industries, Inc; a DMI company.
 - 3. Duro Dyne Inc.
 - 4. Elgen Manufacturing.
 - 5. Ventfabrics, Inc.
 - 6. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.

2.07 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

3.01 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. Compliance with ASHRAE/IESNA 90.1-2004 includes Section 6.4.3.3.3 - "Shutoff Damper Controls," restricts the use of backdraft dampers, and requires control dampers for certain applications. Install [backdraft] [control] dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install flexible connectors to connect ducts to equipment.
- H. Connect flexible ducts to metal ducts with draw bands.
- I. Install duct test holes where required for testing and balancing purposes.

3.02 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect turning vanes for proper and secure installation.
 - 3. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 23 37 13
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL**1.01 RELATED DOCUMENTS**

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Lay-in ceiling Modular core supply grilles.
 - 2. Adjustable double deflection supply grilles.
 - 3. Fixed face registers and grilles.
 - 4. Lay-in ceiling perforated return grilles.
 - 5. Critical Environment laminar flow diffusers.

1.03 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.

PART 2 PRODUCTS**2.01 DIFFUSERS**

- A. See schedule on plans.

2.02 REGISTERS AND GRILLES

- A. See schedule on plans.

2.03 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**3.01 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.

3.02 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.

3.03 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**1.01 RELATED DOCUMENTS**

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Fixed-plate total heat exchangers.
 - 2. Packaged energy recovery units.

1.03 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.
- C. Delegated-Design Submittal: For air-to-air energy recovery equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of air-to-air energy recovery equipment.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 3. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.04 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. Seismic Qualification Data: Certificates, for air-to-air energy recovery equipment, 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.
- C. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

1.06 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. 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."

1.07 COORDINATION

- A. Coordinate layout and installation of air-to-air energy recovery equipment and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air-to-air energy recovery equipment that fail in materials or workmanship within specified warranty period.
 1. Warranty Period for Packaged Energy Recovery Units: Two years.
 2. Warranty Period for Fixed-Plate Total Heat Exchangers: 10 years.

PART 2 PRODUCTS

2.01 FIXED-PLATE TOTAL HEAT EXCHANGERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Mitsubishi Electric Sales Canada Inc.
 2. RenewAire LLC.
 3. Oxygen 8

- B. Casing: Galvanized steel.
- C. Plates: Evenly spaced and sealed and arranged for counter airflow.
 - 1. Plate Material: Chemically treated paper with selective hydroscopicity and moisture permeability, and gas barrier properties.
- D. Bypass Plenum: Within casing, with gasketed face-and-bypass dampers having operating rods extended outside casing.
- E. Disposable Panel Filters:
 - 1. Comply with NFPA 90A.
 - 2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
 - 3. Factory-fabricated, viscous-coated, flat-panel type.
 - 4. MERV: 8, according to ASHRAE 52.2.
 - 5. Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
 - 6. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.
- F. Extended-Surface, Disposable Panel Filters:
 - 1. Comply with NFPA 90A.
 - 2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
 - 3. Factory-fabricated, dry, extended-surface type.
 - 4. MERV: 14, according to ASHRAE 52.2.
 - 5. Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.

2.02 PACKAGED ENERGY RECOVERY UNITS

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

2. Oxygen 8.
 3. American Energy Exchange, Inc.
 4. Applied Air.
 5. Carnes Company.
 6. Des Champs Technologies.
 7. Engineered Air.
 8. Fairchild Industrial Products Company.
 9. Gaylord Industries, Inc.
 10. Greenheck Fan Corporation.
 11. Loren Cook Company.
 12. Mitsubishi Electric & Electronics USA, Inc.
 13. Mitsubishi Electric Sales Canada Inc.
- B. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, hinged access doors with neoprene gaskets for inspection and access to internal parts, thermal insulation, knockouts for electrical and piping connections, exterior drain connection, and lifting lugs.
1. ASHRAE/IESNA 90.1 sets requirements for dampers.
 2. Exhaust: Spring-return, two-position, motor-operated damper.
 3. Supply: Spring-return, two-position, motor-operated damper.
 4. Roof Curb: Refer to Section 077200 "Roof Accessories" for roof curbs and equipment supports.
- D. Heat Recovery Device: Fixed-plate heat exchanger.
1. 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."

2. 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.
 3. Spring isolators on each fan having 1-inch static deflection.
- E. Disposable Panel Filters:
1. Comply with NFPA 90A.
 2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
 3. Factory-fabricated, viscous-coated, flat-panel type.
 4. MERV: 8 according to ASHRAE 52.2.
 5. Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
 6. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.
- F. Extended-Surface, Disposable Panel Filters:
1. Comply with NFPA 90A.
 2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
 3. Factory-fabricated, dry, extended-surface type.
 4. MERV:14 according to ASHRAE 52.2.
 5. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
 6. Media-Grid Frame: Galvanized steel.
 7. Mounting Frames: Welded, galvanized steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.
- G. Cooling Coils: Rated according to ARI 410 and ASHRAE 33, and bearing the ARI label.
1. Access: Fabricate coil section to allow removal and replacement of coil and to allow in-place access for service and maintenance of coil(s).
 2. Leak Test: Coils shall be leak tested with air under water.

3. Refrigerant Coils:
 - a. Capacity Reduction: Circuit coils for face control.
 - b. Suction and Distributor: Seamless copper tube with brazed joints.
4. Coating: Phenolic epoxy corrosion-protection coating after assembly.
- H. Cooling-Coil Condensate Drain Pans:
 1. Fabricated from stainless-steel sheet and sloped in multiple planes to collect and drain condensate from cooling coils, coil piping connections, coil headers, and return bends.
 2. Complying with requirements in ASHRAE 62.1.
 3. Drain Connections: At low point of pan with minimum 3/4" threaded nipple.
 4. Units with stacked coils shall have an intermediate drain pan to collect and drain condensate from top coil.
- I. Electrical Coils, Controls, and Accessories: Comply with UL 1995.
 1. Casing Assembly: Slip-in type with galvanized-steel frame.
 2. Access: Fabricate coil section to allow removal and replacement of coil and to allow in-place access for service.
 3. Sheathed Heating Elements: Coiled resistance wire of 80 percent nickel and 20 percent chromium surrounded by compacted magnesium-oxide powder in tubular-steel sheath; with spiral-wound, copper-plated, steel fins continuously brazed to sheath.
 4. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.
 5. Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.
 6. Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.
 7. Control Panel: Unit or remote mounted with disconnecting means and overcurrent protection.
 - a. Magnetic contactor.
 - b. Solid-state, stepless pulse controller.

- c. Toggle switches, one per step.
 - d. Step controller.
 - e. Time-delay relay.
 - f. Pilot lights, one per step.
 - g. Airflow proving switch.
- J. Piping and Wiring: Fabricate units with space within housing for piping and electrical conduits. Wire motors and controls so only external connections are required during installation.
- 1. Indoor Enclosure: NEMA 250, Type 12 enclosure contains relays, starters, and terminal strip.
 - 2. Outdoor Enclosure: NEMA 250, Type 3R enclosure contains relays, starters, and terminal strip.
 - 3. Include fused disconnect switches.
- K. Accessories:
- 1. Low-Leakage, Isolation Dampers: Double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals, in opposed-blade arrangement with cadmium-plated steel operating rods rotating in stainless-steel sleeve bearings mounted in a single frame, with operating rods connected with a common linkage, and electric damper operator factory wired. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg
 - 2. Isolation Dampers: Opposed-blade, galvanized-steel dampers with cadmium-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame with operating rods connected with a common linkage, and electric damper operator factory wired. Blades shall have gaskets and edge seals, and shall be mechanically fastened to operating rod.
 - 3. Duct flanges.
 - 4. Rubber-in-shear isolators for ceiling-mounted units.
 - 5. Hinged access doors with quarter-turn latches.
 - 6. Drain pans for condensate removal complying with ASHRAE 62.1.
 - 7. Automatic, in-place, spray-wash system.

8. Weatherproofing for tilt-control system.

2.03 CONTROLS

- A. Operating 24/7
- B. Refrigerant-Cooling-Coils Controls:
 1. Remote-mounted sensor for field installation in supply-air duct with sensor adjustment located in control panel to control remote condensing unit to maintain temperature.
 2. Cooling Capacity Control: Multiple steps.
- C. Electric-Coils Controls:
 1. Remote-mounted sensor for field installation in supply-air duct with sensor adjustment located in control panel to control electric coil to maintain temperature.
 2. Coil Controls: Modulating SCR.

2.04 CAPACITIES AND CHARACTERISTICS

- A. See schedule

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

- A. Install heat wheels so supply and exhaust airstreams flow in opposite directions and rotation is away from exhaust side to purge section to supply side.
 1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.

2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
 3. Access doors and panels are specified in Section 233300 "Air Duct Accessories."
- B. Install heat-pipe heat exchangers so supply and exhaust airstreams flow in opposite directions. Install flexible connectors on ducts to enable tilt control; make connections airtight and with slack to compensate for full tilt.
1. Install heat exchanger with clearance space for heat-pipe coil removal.
 2. Install duct access doors in both supply and exhaust ducts, both upstream and downstream, for access to both sides of heat-pipe coil. Access doors and panels are specified in Section 233300 "Air Duct Accessories."
 3. Install tilt-control components, including electronic controller, electric actuator and linkage, thermostats, and sensors.
- C. Install fixed-plate heat exchangers so supply and exhaust airstreams flow in opposite directions.
1. Install duct access doors in both supply and exhaust ducts, both upstream and downstream, for access to heat exchanger. Access doors and panels are specified in Section 233300 "Air Duct Accessories."

3.03 CONNECTIONS

- A. Comply with requirements for piping specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." 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. Connect cooling condensate drain pans with air seal trap at connection to drain pan and install cleanouts at changes in pipe direction.
- E. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping."
- F. Comply with requirements for ductwork specified in Section 233113 "Metal Ducts."
- G. Install electrical devices furnished with units but not factory mounted.

3.04 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.

3.05 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

END OF SECTION

SECTION 23 82 19
VARIABLE REFRIGERANT FLOW HVAC SYSTEM

PART 1 GENERAL**1.01 GENERAL**

- A. The Bidding and Contract Requirements, Division 1 - General Requirements shall apply to this section.

1.02 SCOPE

- A. The work covered under this section shall include the following:
1. Complete variable refrigerant flow system including equipment, piping, and controls. System shall be a VRF (variable refrigerant flow) multi split air conditioning system.
 2. The VRF (Variable Refrigerant Flow) system shall be a simultaneous cooling and heating heat pump system. The VRF system shall consist of an outdoor unit, high efficiency heat recovery units designed for minimum piping and maximum design flexibility, indoor units, and controls by the equipment manufacturer. Each indoor unit shall be independently capable of operating in either heating or cooling mode regardless of the mode of other indoor units.
 3. The variable refrigerant flow system piping system shall be installed by a manufacturer's certified contractor.
 4. The installing contractor shall be trained and certified at the manufacturer's training facility prior to installation, start-up, and commissioning. Submit for review the installation contractor's certification from the manufacturer. This certification shall include the company certification as well as individual certifications for each contractor which will be working on this project.
 5. The refrigeration piping system shall be provided, installed, tested, evacuated, and charged.

1.03 QUALITY ASSURANCE

- A. Manufacturers Field Service - Engage a factory-authorized service representative to inspect field assembled components and equipment installation, including connections, and to assist in field testing.
- B. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label. All wiring shall be in accordance with the National Electrical Code (NEC). The units shall be manufactured in a facility registered to ISO 9001 and ISO14001.

- C. The refrigeration piping system shall be provided, installed, tested, evacuated and charged in accordance with the manufacturer's recommendations, ANSI, ASHRAE, and ARI's Safety Code for Mechanical Refrigeration, state and local codes.
- D. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test - After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test - After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Remove and replace malfunctioning units and retest as specified above.

1.04 SUBMITTALS

- A. Provide shop drawings on this equipment as described in section 15010, 1.04.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers - Provide products by one of the following:
 - 1. Basis of Design: MITSUBISHI ELECTRIC - City Multi VRFZ R2-Series.
 - 2. Substitutions allowed:
 - 3. Daikin, www.daikinac.com/#sle
 - 4. LG Electronics U.S.A., Inc., www.lghvac.com/#sle

2.02 REFRIGERANT COMPONENTS

- A. The equipment specified in this section shall operate with refrigerant R410A - no exceptions or substitutions.
- B. The system shall utilize fully modulating electronic expansion valves.
- C. Refrigerant Piping
 - 1. The refrigerant piping system shall be provided complete and installed in accordance with the manufacturer's recommendations and as specified herein. The size of the refrigerant

pipes shall be obtained from the equipment manufacturer unless otherwise shown on the drawings.

2. Pipe, Fittings, and Accessories - The pipe shall be type ACR 'L' hard drawn copper refrigerant tubing with hard wrought copper fittings. All of the joints shall be brazed with a filler material that complies with AWS classification BCuP-5. A sight glass with moisture indicator shall be provided if not provided with equipment. Use type 'L' copper tubing to pipe the relief valve discharge to the outside.
3. Condensate Drain Piping - Shall be type 'L' copper tubing.
4. Pipe Hangers and Supports - Shall be as required in section 230529.
5. All refrigerant lines shall be insulated from the outdoor unit to the indoor terminal units as shown in section 15250.
6. The system shall be capable of operating with refrigerant piping up to 492 equivalent feet, a total combined length of 984 feet of piping between the condensing and fan coil units with 164 feet maximum vertical difference, without any oil traps or additional equipment. The vertical difference shall not exceed a maximum of 131 feet where the outdoor unit is located below the indoor unit.

2.03 HEAT PUMP CONDENSING UNITS

- A. The outdoor units will have air cooled heat exchange coils constructed from copper tubing with aluminum fins. The coils will be set in a vertical formation with air being drawn in through three sides of the unit and discharged out of the top of the unit. The systems will have a single fan mounted on top of the coils.
- B. The outdoor units will have one inverter controlled hermetic compressor per section. Partial capacity cooling/heating capability must be available. The system shall use a control sequence to ensure that indoor loads are matched to compressor capacity control.
- C. The refrigeration process of the outdoor units will be maintained by pressure and temperature sensors controlling solenoid valves check valves and bypass valves. The heating or cooling mode of the outdoor units will be controlled using a combination of two- and three-way valves which will reverse the cycle of the refrigerant to change the mode of the outdoor unit.
- D. The variable capacity, heat pump air conditioning systems shall be variable refrigerant flow split systems. The systems shall consist of multiple evaporators using PID control and inverter driven outdoor units. The units shall consist of direct expansion (DX), air-cooled heat pump air conditioning systems, variable speed driven compressor multi zone split systems. The outdoor units may connect an indoor evaporator capacity of 50-130% to that of the outdoor

condensing unit capacity. Each indoor unit shall be capable of operating separately with individual temperature control.

- E. The outdoor units shall be interconnected to indoor unit types specified in this section. The indoor units shall be connected to the outdoor units utilizing the specialized piping joints and headers provided by the equipment manufacturer.
- F. General - The outdoor unit is designed specifically for use with manufacturers components:
 - 1. Refrigerant: R410A.
 - 2. The outdoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of a compressor, motors, fans, condenser coil, electronic expansion valve, solenoid valves, four-way valve,
 - 3. distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receivers and accumulators.
 - 4. Both liquid and suction lines shall be individually insulated between the outdoor and indoor units.
 - 5. The outdoor unit shall be wired and piped with outdoor unit access from left, right, rear, or bottom.
 - 6. The connection ratio of indoor units to outdoor unit shall be 50% to 130%.
 - 7. The outdoor unit shall have a sound rating no higher than 63 dB(A).
 - 8. The system shall automatically restart operation after a power failure and shall not cause any settings to be lost, thus eliminating the need for re-programming.
 - 9. The outdoor unit shall be modular in design and should allow for side-by-side installation with minimal spacing.
 - 10. The following safety devices shall be included on the condensing unit: high pressure switch, crankcase heaters, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, and over current protection for the inverter. To ensure the liquid refrigerant does not flash when supplying to the various fan coil units, the circuit shall be provided with a sub-cooling feature. Oil recovery cycle shall be automatic, occurring one hour after system start up, every 7 hours of system operation or as required to maintain oil levels at the system condensing unit.

11. The outdoor unit shall operate in heating mode to -4F dry bulb ambient temperature without additional ambient controls.
- G. Unit Cabinet - The outdoor unit model shall be completely weatherproof and corrosion resistant. The outdoor unit will be constructed from steel plate and treated with acrylic paint, or galvanized steel, bonderized and finished with a powder coated baked enamel.
- H. Fan
1. The condensing units shall consist of a propeller type, direct-drive fan motor that has multiple speed operation via a DC inverter.
 2. The fan motors shall have inherent protection and permanently lubricated bearings and be mounted.
 3. The fan motors shall be provided with a fan guard to prevent contact with moving parts.
- I. Condenser Coil - The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
- J. Compressor
1. The compressor shall be variable speed control capable of changing the speed to follow the variations in total cooling load as determined by the suction gas pressure as measured in the condensing unit.
 2. The inverter driven compressor in each condensing unit shall be a high efficiency DC, hermetically sealed compressor.
 3. The capacity control range shall be a minimum of 20% to 100% of total capacity.
 4. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
 5. Oil separators shall be standard with the equipment together with an oil balancing circuit.
 6. The compressor shall be mounted to avoid the transmission of vibration.
- K. Electrical
1. The power supply to the outdoor unit shall be 208/230 volts, 3 phase, 60 hertz with a voltage range of 187 volts to 253 volts.
 2. The control wiring shall be a two-wire multiple transmission system, making it possible to connect multiple indoor units to one outdoor unit with one 2-cable shielded communications wire.

2.04 HEAT RECOVERY UNITS FOR SIMULTANEOUS HEATING AND COOLING SYSTEMS (BC CONTROLLER)

- A. General - The Heat Recovery Unit shall be designed for use with VRF equipment of the same manufacturer. These units shall be equipped with a circuit board that interfaces to the controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The heat recovery unit shall be completely factory assembled, piped, and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of rated capacity.
- B. Unit Cabinet
1. The casing shall be fabricated of galvanized steel.
 2. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
 3. The unit shall house tube-in-tube heat exchangers.
- C. Refrigerant - R410A refrigerant shall be required for Heat Recovery units in conjunction with outdoor unit systems.
- D. Refrigerant Valves
1. The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and/or three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
 2. Each branch shall have multiple two-position valves to control refrigerant flow for optimum efficiency.
 3. Service shut-off valves shall be installed for each branch to allow service to any indoor unit without field interruption to overall system operation. Shut-off valves shall be full-port ball valves, rated at 700 PSIG, with a Schrader port.
 4. Linear electronic expansion valves shall be used to control the variable refrigerant flow.
- E. Integral Drain Pan - A integral condensate pan and drain, if required, shall be provided.
- F. Electrical
1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
 2. The unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253V (230V/60Hz).
 3. The Heat Recovery unit shall be controlled by integral microprocessors.

4. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.05 INDOOR FAN COIL UNITS

- A. It shall be possible for the total connected capacity of the indoor units to be between 50 and 130% of the capacity of the outdoor unit.
- B. Each indoor unit will have a heat exchanger which shall be constructed from copper tubing with aluminum fins. The flow of refrigerant through the heat exchanger will be controlled by an electronic proportional expansion valve. This valve will be controlled by two pipe thermistors, a return air and discharge air thermistor and shall be capable of controlling the variable capacity of the indoor unit between 25% and 100%.
- C. Each indoor unit shall have an operating voltage of 208-230V/1 phase/60Hz. The indoor unit shall supply demand capacity information to the outdoor unit via its control algorithm.
- D. See INDOOR UNIT equipment schedule on drawing sheet M2.00 for Makes/models
- E. General:
 1. The PEFY-NMSU (Low Profile) unit shall be a ceiling-concealed ducted indoor fan coil that mounts above the ceiling with a rear return and a fixed horizontal discharge supply and shall have a modulating linear expansion device. The PEFY-NMSU shall be used with the R2-Series outdoor unit and BC Controller, Y-Series outdoor unit, or S-Series outdoor unit. The PEFY-NMSU shall support individual control using M-NET DDC controllers. PEFY (Low Profile) models shall have an extremely compact profile (7-7/8") which requires minimal ceiling space. PEFY-NMSU models shall feature external static pressure settings up to 0.20 in. WG. Units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.
- F. Indoor Unit.
 1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- G. Unit Cabinet:
 1. The cabinet shall be space saving, low profile, ceiling-concealed ducted.
 2. The cabinet panel shall have provisions for a field installed filtered outside air intake.

H. Fan:

1. The indoor unit fan shall be an assembly with one Sirocco fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of three (3) speeds, High, Mid, and Low.
4. The indoor unit shall have a ducted air outlet system and ducted return air system.

I. Filter:

1. Return air shall be filtered by means of a standard factory installed return air filter.

J. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The unit shall be provided with an integral condensate lift mechanism able to raise drain water 21 inches above the condensate pan.
7. Both refrigerant lines to the PEFY indoor units shall be insulated.

K. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

L. Controls:

1. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system.

2.06 PEFY-NMHU (ALTERNATE HIGH STATIC OPTION), CEILING-CONCEALED DUCTED INDOOR UNIT**A. General:**

1. The PEFY-NMHU (Alternate High Static Option) unit shall be a ceiling concealed ducted indoor fan coil that mounts above the ceiling with a fixed rear return and a horizontal discharge supply, and shall have a modulating linear expansion device. The PEFY-NMHU shall be used with the R2-Series outdoor unit and BC Controller, Y-Series outdoor unit, or S-Series outdoor unit. The PEFY-NMLU shall support individual control using M-NET DDC controllers. PEFY-NMHU (Alternate High Static Option) models shall feature external static pressure settings up 0.80 in. WG. Units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.
2. The PLFY unit shall be a ceiling cassette fan coil unit for installation into the ceiling cavity equipped with an air panel grille to be connected to indoor unit as scheduled and specified in this section. The indoor unit shall have a four-way air distribution type, impact resistant and washable decoration panel. The supply air shall be distributed via motorized louvers which can be horizontally and vertically adjusted from 0 degree to 90 degree angle.

B. Indoor Unit.

1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:

1. The cabinet shall be ceiling-concealed, ducted.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake.

D. Fan:

1. The indoor unit fan shall be an assembly with one or two Sirocco fan(s) direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor unit shall have a ducted air outlet system and ducted return air system.

E. Filter:

1. Return air shall be filtered by a field-supplied filter.
2. Optional rear return filter box with long-life filter shall available for all PEFY-NMHU-E indoor units.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The condensate shall be gravity drained from the fan coil.
7. Both refrigerant lines to the PEFY indoor units shall be insulated.

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

H. Controls:

1. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system.

2.07 CONTROLLERS

A. Physical Characteristics - The control system shall be a neutral color plastic material with a Liquid Crystal Display (LCD).

B. Electrical Characteristics

1. General - From each circuit board to the controls, the electrical voltage shall be 16 - 24 volts DC.
2. Wiring: Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit then to the outdoor unit. Control wiring shall run from the indoor unit terminal block to the specific controller for that unit.

3. Wiring Size: The wire shall be a shielded, size AWG16-2 or AWG 18-2.
- C. Individual Zone Controller B Simplified Wired Remote Controller
1. The simplified wired remote controller shall be able to control 1 group (minimum of 16 fan coil units).
 2. The simplified wired remote controller shall have the following features:
 - a. Operation - Start/Stop, Operation Mode, Temperature Setting, 60F - 90F Set Point Range, Fan Speed, Airflow Direction.
 - b. Monitoring - Status, malfunction flashing, malfunction content, filter sign, operation mode, temperature setting, permit/prohibit selection, fan speed, airflow direction.
 - c. Scheduling - ON/OFF Timer.
 - d. Control Management - Field Setting Mode, Group Setting, Auto Restart.
- D. System Remote Controller - The controller shall control up to 50 units in 4 zones and shall be able to be used in conjunction with all room controller types. Collective and individual group commands are available with permit/prohibit individual remote controller function. The system controller shall use the following connections for power and remote monitoring:

2.08 L1: POWER SUPPLY (60 HZ, 208-230 VAC)

2.09 INTER-UNIT CONTROL WIRING (LOW VOLTAGE)

- A. Auxiliary
- B. Ground for inter-unit control wiring
- C. Input for turning ON air conditioners concurrently
- D. Input for turning OFF air conditioners concurrently
- E. Common input for turning air conditioners ON or OFF
- F. On operation state indicator output
- G. Alarm indicator output
- H. Common indicator output
- I. Web Enabled Intelligent Controller (Centralized Controller, locate in Mech. Rm.)

1. This controller shall be wall mounted and hard wired. It will be manufactured with an LCD display and will be the manufacturers standard color. The controller will be capable of individually controlling the following functions on at least 10 indoor fan coil units:
 - a. On/off.
 - b. Operating mode.
 - c. Set point.
 - d. Fan speed.
 - e. Louver position.
 - f. Timer settings.
 - g. Test run.
2. The controller shall also be capable of displaying the following information individually for at least 50 indoor fan coil units:
 - a. On/off.
 - b. Operating mode.
 - c. Set point.
 - d. Fan speed.
 - e. Louver position.
 - f. Timer settings.
 - g. Test run.
 - h. Fault diagnosis.
3. Each Intelligent controller unit shall be accessed both locally and remotely via standard Internet Explorer IE6 or IE7 software. The Intelligent controller will be able to indicate system alarms via volt free contacts as well as providing control points for other DO devices. Additionally, the intelligent controller shall be able to monitor individual usage of heating and cooling demands, report alarm and conditions to nominated email address, and enable remote alteration of systems setpoints and schedules.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all piping, fittings, and insulation to meet manufacturers requirements. Install units level and plumb. Evaporator-fan components shall be installed using manufacturers standard mounting devices securely fastened to building structure. Install and connect refrigerant tubing and fittings.
- B. Installer shall supply isolation ball valves for zoned refrigerant isolation. Installer shall supply Isolation ball valves with Schrader connection for isolating refrigerant charge and evacuation at each connected air handling unit and condensing unit. Isolation ball valves, with Schrader connection, are required for instances of air handling unit isolation for troubleshooting, repair, or replacement without affecting the remainder of the system. Isolation ball valves with Schrader connection are also required at condensing unit connection to isolate unit for troubleshooting, repair or replacement and as required to provide partial capacity Heating/Cooling in the instance of a failure of one of the multiple outdoor unit (condensing unit) compressors.
- C. During brazing an inert gas (such as nitrogen) shall be continuously passed through the system at a rate sufficient to maintain an oxygen free environment to prevent the formation of copper oxide scale. After piping has been completed, the refrigerant piping system shall be pressure tested at a pressure of 300 psi on the high side and 150 psi on the low side. The pressure shall be maintained on the system for a minimum of 12 hours. The system shall be evacuated when the surrounding ambient air is not less than 60 F. If the temperature is less, auxiliary heat must be provided to insure proper evacuating conditions. A minimum vacuum of 500 Microns of Hg. shall be pulled on the system and maintained for 12 hours. The vacuum pump displacement shall be not less than 2 cfm for up to 15 tons. The system shall be charged as recommended by the equipment manufacturer.
- D. Electrical wiring required by this section, both high and low voltage, shall comply with the Division 16 requirements.
- E. Start Up –Engage manufacturer or factory-authorized service representative to perform startup service. Manufacturer shall provide on-site startup and commissioning assistance through job completion. Complete installation and startup checks according to manufacturer’s written instructions. This shall include a factory startup for factory provided control devices as well as configuring control points for other DO devices. Service representative shall completely configure all control devices. Confirm with owner if it is required to establish remote internet connectivity with the owner’s energy management department web server and, if confirmed, establish connectivity.

- F. Demonstration - Engage manufacturer or factory-authorized service representative to train Owners maintenance personnel to adjust, operate and maintain individual units and complete system. This shall include training of the owner's energy management department representatives as to establish control system programming, scheduling routines, alarm reporting, system topography, communication protocols and password level assignments.
- G. The indoor air handling and outside condensing units shall be installed in accordance with the manufacturer's recommendations and as shown on the drawings. The first unit installed will be considered the typical mock up and shall require notification, inspection and approval by the designated owner representative and/or architect and engineer before any additional installations will be allowed.
- H. Warranty Tag - The Contractor shall attach an engraved weatherproof Guarantee or Warranty tag to the exterior of each condensing unit. Tag is to be screwed or riveted to unit. Identification tag shall be black with engraved 3" white letters which reads:

3.02 UNIT # (UNIT NUMBER)

3.03 INSTALLED BY: (CONTRACTING COMPANY'S NAME)

3.04 WARRANTY EXPIRES: (MONTH/DAY/YEAR)

3.05 COMPRESSOR WARRANTY EXPIRES: (MONTH/DAY/YEAR)

END OF SECTION 238219

SECTION 26 05 05
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Electrical demolition.

1.02 RELATED REQUIREMENTS

- A. Section 01 70 00 - Execution and Closeout Requirements: Additional requirements for alterations work.

PART 2 PRODUCTS**2.01 MATERIALS AND EQUIPMENT**

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify field measurements and circuiting arrangements are as indicated.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on non-destructive field observation and existing documents provided by the Owner.
- D. Report discrepancies to Owner before disturbing existing installation.
- E. Report discrepancies to Architect before disturbing existing installation.
- F. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

- D. Existing Electrical Service: Maintain existing system in service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.
- E. Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Notify Owner before partially or completely disabling system.
 - 2. Notify local fire service.
 - 3. Make notifications at least 24 hours in advance.
 - 4. Make temporary connections to maintain service in areas adjacent to work area.
- F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Notify Owner at least 24 hours before partially or completely disabling system.
 - 2. Notify telephone utility company at least 24 hours before partially or completely disabling system.
 - 3. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- E. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

- F. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- G. Repair adjacent construction and finishes damaged during demolition and extension work.
- H. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

3.04 CLEANING AND REPAIR

- A. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.
- B. Clean and repair existing materials and equipment that remain or that are to be reused.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Single conductor building wire.
- B. Wiring connectors.
- C. Electrical tape.
- D. Heat shrink tubing.
- E. Wire pulling lubricant.
- F. Cable ties.
- G. Firestop sleeves.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 05 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire 2013.
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010 (Reapproved 2014).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2014).

- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2010.
- F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes 2013.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction 2010.
- H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2009.
- I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2013.
- J. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 44 - Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.
- L. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.
- M. UL 267 - Outline of Investigation for Wire-Pulling Compounds Most Recent Edition, Including All Revisions.
- N. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.
- O. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.
- P. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.
- Q. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.

1.04 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.

1.05 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. 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. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.
- 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.

1.06 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. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 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**PART 3 EXECUTION****3.01 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.

3.02 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 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 permitted, under the following conditions:
 - 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 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 feeding electrified furniture systems will have shared neutrals and shared ground conductors].
- 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. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet (1.5 m) of slack.
- J. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- K. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- L. 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.
- M. 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 or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 - b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by 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.
- N. Insulate ends of spare conductors using vinyl insulating electrical tape.
- O. 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.
- P. Identify conductors and cables in accordance with Section 26 05 53.
- Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- R. 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.

3.04 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 only required for services and feeders. The resistance test for parallel conductors listed as optional is 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

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL**1.01 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 access wells.

1.02 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.
 - 1. Includes oxide inhibiting compound.
- B. Section 26 05 36 - Cable Trays for Electrical Systems: Additional grounding and bonding requirements for cable tray systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 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 2010.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings 2007.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2013.
- 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.

1.04 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.

1.05 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.

1.06 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. Electronic copy is acceptable.
- 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.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 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/Engineer. 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.
- 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 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 4 by 12 inches (6 by 100 by 300 mm) unless otherwise indicated on the drawings.
 - 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. 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. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
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.

2.02 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:
 - 1) Use mechanical connectors for connections to electrodes at ground access wells.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
4. Manufacturers - Mechanical and Compression Connectors:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Burndy LLC: www.burndy.com/#sle.
 - c. Harger Lightning & Grounding: www.harger.com/#sle.
 - d. Thomas & Betts Corporation: www.tnb.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
5. Manufacturers - Exothermic Welded Connections:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. Cadweld, a brand of Erico International Corporation: www.erico.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 required for the connections to be made unless noted on the drawings..
 4. Manufacturers:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. Harger Lightning & Grounding: www.harger.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.
- 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 on the drawings.
 4. Manufacturers:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. Galvan Industries, Inc: www.galvanelectrical.com/#sle.
 - d. Harger Lightning & Grounding: www.harger.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- F. 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.
 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.
- b. Rectangular Wells: Not less than 12 by 12 inches (300 by 300 mm).
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. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. Harger Lightning & Grounding: www.harger.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.
- G. Oxide Inhibiting Compound: Comply with Section 26 05 19.

PART 3 EXECUTION

3.01 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.

3.02 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.
 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.

3.03 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

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 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.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2015.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2009.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2013.
- D. MFMA-4 - Metal Framing Standards Publication 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction 2010.

- F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 5B - Strut-Type Channel Raceways and Fittings Current Edition, Including All Revisions.

1.04 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.

1.05 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.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- D. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.

1.06 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.

- 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.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. NFPA 70.
 - b. 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 the 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. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

- c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel.
 2. Conduit Clamps: Bolted type unless otherwise indicated.
 3. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - e. Thomas & Betts Corporation: www.tnb.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
1. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - e. Thomas & Betts Corporation: www.tnb.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Metal Channel/Strut Framing Systems:
1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.

2. Comply with MFMA-4.
 3. Channel/Strut Used as Raceway, Where Indicated: Listed and labeled as complying with UL 5B.
 4. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or 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.
 7. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Thomas & Betts Corporation: www.tnb.com/#sle.
 - c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
- E. 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.
- F. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
1. 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.

2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
4. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.
5. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. PHP Systems/Design: www.phpsd.com/#sle.
 - d. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

G. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are permitted only as follows:
 - a. Where approved by Architect.

- b. Use only threaded studs; do not use pins.
11. Hammer-driven anchors and fasteners are not permitted.
 12. 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.
 - e. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
 13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
 14. Manufacturers - Mechanical Anchors:
 - a. Hilti, Inc: www.us.hilti.com/#sle.
 - b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 - c. Powers Fasteners, Inc: www.powers.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 15. Manufacturers - Powder-Actuated Fastening Systems:
 - a. Hilti, Inc: www.us.hilti.com/#sle.
 - b. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
 - c. Powers Fasteners, Inc: www.powers.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION**3.01 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.

3.02 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. Field Welding, Where Approved by Architect: See Section 05 50 00.
- J. 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.
- K. Conduit Support and Attachment: See Section 26 05 33.13 for additional requirements.
- L. Box Support and Attachment: See Section 26 05 33.16 for additional requirements.
- M. Interior Luminaire Support and Attachment: See Section 26 51 00 for additional requirements.
- N. Exterior Luminaire Support and Attachment: See Section 26 56 00 for additional requirements.
- O. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- P. Secure fasteners in accordance with manufacturer's recommended torque settings.
- Q. Remove temporary supports.
- R. Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 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

SECTION 26 05 33.13
CONDUIT FOR ELECTRICAL SYSTEMS**PART 1 GENERAL****1.01 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. Conduit fittings.
- L. Accessories.

1.02 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 26 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- D. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- E. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
- F. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

- G. Section 26 21 00 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
- H. Section 27 05 33.13 - Conduit for Communications Systems.
- I. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC) 2015.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S) 2015.
- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC) 2005.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction 2010.
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2013.
- F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) 2003.
- 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 Conduit and Intermediate Metal Conduit 2005 (R2013).
- I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2013.
- J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing 2015.
- 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 Steel 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 797A - Electrical Metallic Tubing - Aluminum and Stainless Steel Current Edition, Including All Revisions.
- U. UL 1242 - Electrical Intermediate Metal Conduit-Steel Current Edition, Including All Revisions.
- V. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds Current Edition, Including All Revisions.

1.04 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.

1.05 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.

- 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.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 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. Under Slab on Grade: Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.
 - 2. Exterior, Direct-Buried: Use rigid PVC conduit.
 - 3. Exterior, Embedded Within Concrete: Use rigid PVC conduit.
 - 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit or PVC-coated galvanized steel rigid metal conduit where emerging from underground.
 - 5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use PVC-coated galvanized steel rigid metal conduit elbows for bends.
 - 6. Where steel conduit is installed in direct contact with earth, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.

7. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches (100 mm) on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.
- D. Embedded Within Concrete:
1. Within Slab on Grade: Not permitted.
 2. Within Slab Above Ground (within structural slabs only where approved by Structural Engineer) only as approved by Architect: Use rigid PVC conduit.
 3. Within Concrete Walls Above Ground: Use intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
 4. Where rigid polyvinyl (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 galvanized steel electrical metallic tubing (EMT) where emerging from concrete.
 5. Where galvanized steel electrical metallic tubing (EMT) emerges from concrete into salt air, 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.
- E. Concealed Within Masonry Walls: Use electrical metallic tubing (EMT).
- F. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT).
- G. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT).
- H. 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).
- I. Exposed, Interior, Not Subject to Physical Damage: Use electrical metallic tubing (EMT).
- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal 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.

- K. Exposed, Exterior: Use galvanized steel rigid metal conduit.
- L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use electrical metallic tubing (EMT).
- M. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
 - 1. Maximum Length: 6 feet (1.8 m).
- N. Flexible Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit (FMC).
 - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
 - 3. Maximum Length: 6 feet (1.8 m) unless otherwise indicated.
 - 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.

2.02 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.
- B. Electrical Service Conduits: See Section 26 21 00 for additional requirements.
- C. Communications Systems Conduits: Also comply with Section 27 10 00.
- D. Fittings for Grounding and Bonding: See Section 26 05 26 for additional requirements.
- E. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- F. Provide products listed, classified, and labeled as suitable for purpose intended.
- G. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4 inch (21 mm) trade size.
 - 2. Branch Circuit Homeruns: 3/4-inch (21 mm) trade size.
 - 3. Control Circuits: 1/2-inch (16 mm) trade size.
 - 4. Flexible Connections to Luminaires: 3/8-inch (12 mm) trade size.

5. Underground, Interior: 1 inch (27 mm) trade size.
 6. Underground, Exterior: 1-inch (27 mm) trade size.
- H. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:

1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#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. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
- b. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
- c. Thomas & Betts Corporation: www.tnb.com/#sle.
- d. 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. Material: Use steel.

- a. Do not use die cast zinc fittings.

4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.04 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.

2.05 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#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. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - b. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. 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. Material: Use steel.

- a. Do not use die cast zinc fittings.
4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.06 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.

2.07 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 1. Thomas & Betts Corporation: www.tnb.com/#sle.
 2. Robroy Industries: www.robroy.com/#sle.
 3. 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).
- E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch (0.38 mm).

2.08 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
 - 2. Electri-Flex Company: www.electriflex.com/#sle.
 - 3. International Metal Hose: www.metalhose.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - b. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel.
 - a. Do not use die cast zinc fittings.

2.09 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- 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.

2.10 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
2. Nucor Tubular Products: www.nucortubular/#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 EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:

1. Manufacturers:

- a. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
- b. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
- c. Thomas & Betts Corporation: www.tnb.com/#sle.
- d. Substitutions: See Section 01 60 00 - Product Requirements.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Material: Use steel.

- a. Do not use die cast zinc fittings.

4. Connectors and Couplings: Use compression/gland or set-screw type.

- a. Do not use indenter type connectors and couplings.

5. Damp or Wet Locations, Where Permitted: Use fittings listed for use in wet locations.

6. Embedded Within Concrete, Where Permitted: Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.11 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. Connectors and Couplings: Use compression/gland or set-screw type.

2.12 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
 - 1. Cantex Inc: www.cantexinc.com/#sle.
 - 2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
 - 3. JM Eagle: www.jmeagle.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. 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.
- C. 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.

2.13 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch (0.51 mm).
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

- D. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf (5.6 kN).
- E. Sealing Compound for Hazardous/Classified Location Sealing Fittings: Listed for use with particular fittings to be installed.
- F. Sealing Systems for Concrete Penetrations:
 - 1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
 - 2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.
- G. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
- H. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
- I. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
- J. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for conduit/duct arrangement to be installed.
- K. Bore Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for installation within casing; furnished with roller wheels to facilitate installation, openings to facilitate grout flow, and holes for stabilization cable; suitable for casing and conduit/duct arrangement to be installed.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.

- B. Install conduit in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install intermediate metal conduit (IMC) in accordance with NECA 101.
- E. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by manufacturer.
- F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- G. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated without specific routing, determine exact routing required.
 - 3. Conceal conduits unless specifically indicated to be exposed.
 - 4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - 5. Unless otherwise approved, do not route exposed conduits:
 - a. Across floors.
 - b. Across roofs.
 - c. Across top of parapet walls.
 - d. Across building exterior surfaces.
 - 6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 - 7. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
 - 9. Route conduits above water and drain piping where possible.

10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
11. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
12. Maintain minimum clearance of 12 inches (300 mm) between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
13. Group parallel conduits in same area on common rack.

H. 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 required vibration isolation and/or seismic controls; see Section 26 05 48.
3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
4. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
5. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
6. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
7. Use conduit clamp to support single conduit from beam clamp or threaded rod.
8. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
9. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
10. Use of wire for support of conduits is permitted only as follows:

- a. For securing conduits to studs in hollow stud walls.
 - b. For suspending conduits supported by spring steel conduit clips, where specifically indicated or permitted.
11. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.
- 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. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 6. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
 7. 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 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. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
 6. Provide suitable sealing system where conduits penetrate exterior wall below grade.

7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 8. 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.
 9. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 84 00.
- K. Underground Installation:
1. Provide trenching and backfilling; see Section 31 23 16.13.
 2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 36 inches.
 - b. Under Slab on Grade: 12 inches (300 mm) to bottom of slab.
 3. Provide underground warning tape in accordance with Section 26 05 53 along entire conduit length.
- L. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
1. Include proposed conduit arrangement with submittals.
 2. Maximum Conduit Size: 1-inch (27 mm) trade size unless otherwise approved.
 3. Install conduits within middle one third of slab thickness.
 4. Secure conduits to prevent floating or movement during pouring of concrete.
- M. 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.
- N. 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.
- O. 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.
- P. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- Q. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches (300 mm) at each end.
- R. Provide grounding and bonding; see Section 26 05 26.
- S. Identify conduits; see Section 26 05 53.

3.03 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.

3.04 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 26 05 33.16
BOXES FOR ELECTRICAL SYSTEMS**PART 1 GENERAL****1.01 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. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- 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. Additional requirements for locating boxes for wiring devices.
- G. Section 26 28 13 - Fuses: Spare fuse cabinets.
- H. Section 27 10 00 - Structured Cabling: Additional requirements for communications systems outlet boxes.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2010.

- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2010.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2014.
- 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.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2014.
- G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- 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.

1.04 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 minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
 - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
 - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
 - 6. Coordinate the work with other trades to preserve insulation integrity.

7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 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 outlet and device boxes, junction and pull boxes, and cabinets and enclosures.
- C. Project Record Documents: Record actual locations for cabinets and enclosures and underground boxes/enclosures.
- D. 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. Keys for Lockable Enclosures: Two of each different key.

1.06 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. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 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 cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
 4. Use suitable concrete type boxes where flush-mounted in concrete.
 5. Use suitable masonry type boxes where flush-mounted in masonry walls.
 6. Use raised covers suitable for the type of wall construction and device configuration where required.
 7. Use shallow boxes where required by the type of wall construction.
 8. Do not use "through-wall" boxes designed for access from both sides of wall.
 9. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 11. 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.
 12. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.

13. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Communications Systems Outlets: Comply with Section 27 10 00.
 - c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
14. Wall Plates: Comply with Section 26 27 26.
- 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:
 - a. Indoor Clean, Dry Locations: Type 1, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 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. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 - b. Back Panels: Painted steel, removable.
 - c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
 5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
 6. 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.

2.02 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.

PART 3 EXECUTION

3.01 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.

3.02 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. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
 - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required.
 - 2. Unless dimensioned, box locations indicated are approximate.
 - 3. Locate boxes as required for devices installed under other sections or by others.

- a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
 - b. 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.
 - b. Do not install flush-mounted boxes with area larger than 16 square inches (0.0103 sq m) or such that the total aggregate area of openings exceeds 100 square inches (0.0645 sq m) for any 100 square feet (9.29 sq m) of wall area.
 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.
- I. 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. Do not provide support from piping, ductwork, or other systems.
 3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
 4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.
- J. Install boxes plumb and level.
- K. 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.
- 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. Underground Boxes/Enclosures:
1. Install enclosure on gravel base, minimum 6 inches (150 mm) deep.
 2. Flush-mount enclosures located in concrete or paved areas.
 3. Mount enclosures located in landscaped areas with top at 1 inch (25 mm) above finished grade.
 4. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
- O. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- Q. Close unused box openings.
- R. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- S. Provide grounding and bonding in accordance with Section 26 05 26.
- T. Identify boxes in accordance with Section 26 05 53.

3.03 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 05 36
CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Metal cable tray systems:
 - 1. Metal wire mesh/basket cable tray.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- 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.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2015.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2015.
- C. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings 2009 (Reapproved 2015).
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction 2010.
- E. NEMA VE 1 - Metal Cable Tray Systems 2009.
- F. NEMA VE 2 - Cable Tray Installation Guidelines 2013, with Errata 2016.
- G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate the arrangement of cable tray with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others. Coordinate the work with other trades to avoid installation of obstructions within cable tray required clearances.
 2. Coordinate arrangement of cable tray with the dimensions and clearance requirements of the actual products to be installed.
 3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
 4. Notify of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Preinstallation Meeting: Convene one week prior to commencing work of this section; require attendance of all affected installers. Review proposed routing, sequence of installation, and protection requirements for installed cable tray.
- C. Sequencing:
1. Do not begin installation of cables until installation of associated cable tray run is complete.

1.05 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 cable tray system components and accessories. Include dimensions, materials, fabrication details, finishes, and span/load ratings.
- C. Shop Drawings: Include dimensioned plan views and sections indicating proposed cable tray routing, required clearances, and locations and details of supports, fittings, building element penetrations, and equipment connections.
- D. 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.
- E. Project Record Documents: Record actual routing of cable tray and locations of supports.

1.06 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.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NEMA VE 2, except do not store cable tray outdoors without cover as permitted in NEMA VE 2.
- B. Handle products carefully to avoid damage to finish.

PART 2 PRODUCTS

2.01 CABLE TRAY SYSTEM - GENERAL REQUIREMENTS

- A. Provide new cable tray system consisting of all required components, fittings, supports, accessories, etc. as necessary for a complete system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Do not use cable tray for applications other than as permitted by NFPA 70 and product listing/classification.
- D. Provide cable tray system and associated components suitable for use at indicated span/load ratings under the service conditions at the installed location.
- E. Unless otherwise indicated, specified span/load ratings are based on safety factor of 1.5 and working load only (no additional concentrated static load), with ratings for metal cable tray systems in accordance with NEMA VE 1.
- F. Unless otherwise indicated, specified load/fill depths and inside widths are nominal values, with values for metal cable tray systems in accordance with NEMA VE 1 including applicable allowable tolerances.

2.02 METAL CABLE TRAY SYSTEMS

- A. Manufacturers:
 - 1. Metal Cable Tray System:
 - a. Cablofil, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
 - b. Chalfant Manufacturing Company; _____: www.chalfant-obo.com/#sle.
 - c. Cope, a brand of Atkore International Inc; _____: www.copecabletray.com/#sle.

- d. B-Line, a brand fo Eaton Corporation: www.eaton.com
 - e. Hubbell Corporation: www.hubbell.com
 - f. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.
 3. 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.
 4. Source Limitations: Furnish cable tray system and associated components and accessories produced by a single manufacturer and obtained from a single supplier.
- B. Comply with NEMA VE 1.
- C. Finishes:
1. Mill-Galvanized Before Fabrication (Pre-Galvanized) Steel: Comply with ASTM A653/A653M, G90 coating.
 2. Hot-Dip Galvanized After Fabrication (H.D.G.A.F.) Steel: Comply with ASTM A123/A123M.
- D. Metal Wire Mesh/Basket Cable Tray:
1. Material: Mill-galvanized before fabrication (pre-galvanized) steel.
 2. Tray Depth: As indicated on drawings.
 3. Span/Load Rating: As indicated on drawings.
 4. Mesh Spacing: 2 by 4 inches (51 by 102 mm).
 5. Tray Width: As indicated on drawings.

2.03 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Metal Cable Tray: Perform factory design tests in accordance with NEMA VE 1, including electrical continuity and load testing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that work likely to damage cable tray system has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that the dimensions and span/load ratings of cable tray system components are consistent with the indicated requirements.
- D. Verify that mounting surfaces are ready to receive cable tray and associated supports.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install cable tray in accordance with NECA 1 (general workmanship), and NEMA VE 2.
- C. Unless otherwise indicated, arrange cable tray to be parallel or perpendicular to building lines.
- D. Arrange cable tray to provide required clearances and maintain cable access.
- E. Install cable tray plumb and level, with sections aligned and with horizontal runs at the proper elevation.
- F. Metal Wire Mesh/Basket Cable Tray: Field fabricate fittings in accordance with manufacturer's instructions, using only manufacturer-approved connectors classified for bonding.
 - 1. Inside Radius of Fittings: 12 inches (305 mm).
- G. Hot-Dip Galvanized After Fabrication (H.D.G.A.F.) Steel Cable Tray: After cutting, drilling, or deburring, use approved zinc-rich paint to repair finish in accordance with ASTM A780/A780M.
- H. Cable Tray Movement Provisions:
 - 1. Provide suitable expansion fittings where cable tray is subject to movement, including but not limited to:
 - a. Where cable tray crosses structural joints intended for expansion.
 - b. Long straight cable tray runs in accordance with NEMA VE 2.
 - 2. Use expansion guides in lieu of hold-down clamps where prescribed in NEMA VE 2.
 - 3. Set gaps for expansion fittings in accordance with NEMA VE 2.

- I. Cable Provisions:
 - 1. Use suitable fixed barrier strips to maintain separation of cables as indicated and as required by NFPA 70.
 - 2. Use suitable drop-out fittings or bushings where cables exit cable tray as required to maintain minimum cable bending radius.
 - 3. Use suitable cable support fittings for long vertical cable tray runs with heavy cables.
- J. Provide end closures at unconnected ends of cable tray runs.
- K. Cable Tray Support:
 - 1. Use manufacturer's recommended hangers and supports, located in accordance with NEMA VE 2 and manufacturer's requirements, but not exceeding specified span unless otherwise approved by Engineer. Provide required support and attachment in accordance with Section 26 05 29, where not furnished by cable tray manufacturer.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- L. Grounding and Bonding Requirements, in Addition to Requirements of Section 26 05 26:
 - 1. Comply with grounding and bonding requirements of NEMA VE 2.
 - 2. Metal Cable Tray Systems: Use suitable bonding jumpers or classified connectors to provide electrical continuity.
 - 3. Provide suitable equipment grounding conductor in each cable tray. Do not use metal cable tray system as sole equipment grounding conductor.
 - a. Equipment Grounding Conductor for Steel Cable Tray: Use insulated copper conductor.
 - b. Minimum Equipment Grounding Conductor Size: 6 AWG copper.
 - c. Bond equipment grounding conductor to each cable tray section using suitable listed ground clamps. Separate bonding jumpers are not required where properly bonded equipment grounding conductor provides equivalent continuity.
- M. Conduit Termination:
 - 1. Use listed cable tray conduit clamps (evaluated for bonding connection) to terminate conduits at cable tray.

2. Provide insulating bushing at conduit termination to protect cables.
 3. Provide independent support for conduit.
- N. Penetrations: Install firestopping to preserve fire resistance rating of building elements, using materials and methods specified in Section 07 84 00.
- O. Identification Requirements, in Addition to Those Specified in Section 26 05 53.
- P. Install cable tray covers where indicated and as follows:
1. For first 6 feet (1.8 m) of cable tray extending vertically from a floor penetration.
 2. Where cable tray passes under open walkways.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect cable tray system 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 cable tray system components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Remove dirt and debris from cable tray.
- B. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 PROTECTION

- A. Protect cable tray system from subsequent construction operations.

END OF SECTION

SECTION 26 05 48
VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Vibration isolation requirements.
- B. Seismic control requirements.
 - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- C. Vibration-isolated equipment support bases.
- D. Vibration isolators.
- E. External seismic snubber assemblies.
- F. Seismic restraint systems.

1.02 RELATED REQUIREMENTS

- A. Section 01 45 33 - Code-Required Special Inspections and Procedures.
- B. Section 03 30 00 - Cast-in-Place Concrete.

1.03 DEFINITIONS

- A. Electrical Component: Where referenced in this section in regards to seismic controls, applies to any portion of the electrical system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., conduit, cable tray).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures 2010, with 2013 Supplements and Errata.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings 2016.
- C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications 2015.

- D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions 2020.
- E. FEMA 413 - Installing Seismic Restraints for Electrical Equipment 2004.
- F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage 2011.
- G. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components 2010, with Editorial Revision (2015).
- H. MFMA-4 - Metal Framing Standards Publication 2004.
- I. NECA 1 - Standard for Good Workmanship in Electrical Construction 2010.
- J. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; Sheet Metal and Air Conditioning Contractors' National Association 2008.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Seismic Controls:
 - a. Coordinate the arrangement of seismic restraints with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
 - 5. Notify Architect of any 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 fully cured in accordance with Section 03 30 00.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
 2. Seismic Controls: Include seismic load capacities.
- D. Shop Drawings - Vibration Isolation Systems:
 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
 2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
- E. Shop Drawings - Seismic Controls:
 1. Include dimensioned plan views and sections indicating proposed electrical component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
 2. Identify mounting conditions required for equipment seismic qualification.
 3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
 4. Indicate proposed arrangement of distributed system trapeze support groupings.
 5. Indicate proposed locations for distributed system flexible fittings and/or connections.
 6. Indicate locations of seismic separations where applicable.
- F. Seismic Design Data:

1. Compile information on project-specific characteristics of actual installed electrical components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
 - a. Component operating weight and center of gravity.
 - b. Component elevation in the building in relation to the roof elevation (z/h).
 - c. Component importance factor (I_p).
 - d. For distributed systems, component materials and connection methods.
 - e. Component amplification factor (a_p) and component response modification factor (R_p), determined in accordance with ASCE 7 tables.
 - f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).
 2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.
- G. Certification for seismically qualified equipment; identify basis for certification.
- H. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.
- I. 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.
- J. Evidence of qualifications for seismic controls designer.
- K. Evidence of qualifications for manufacturer.
- L. Manufacturer's detailed field testing and inspection procedures.
- M. Field quality control test reports.

1.07 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.
- C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

- D. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
 - 1. Designer may be employed by the manufacturer of the seismic restraint products.
- E. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing electrical equipment and/or electrical connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 - 1. Select vibration isolators to provide required static deflection.
 - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
 - 3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
 - 4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
 - 5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch (50 mm) operating clearance beneath base unless otherwise indicated.
- D. Equipment Isolation:
 - 1. Transformers:

- a. Specified vibration isolators are in addition to any factory-installed internal core and coil assembly vibration isolators unless otherwise indicated.
 - b. Floor-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts or seismic type restrained spring isolators.
 - c. Suspended Transformers, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
 - d. Wall-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts.
 - e. Minimum Static Deflection:
 - 1) Transformers Mounted on Grade-Level Slabs: 0.25 inch (6 mm) deflection unless otherwise indicated.
 - 2) Transformers Mounted at Above-Grade Levels: 0.5 inch (12 mm) deflection unless otherwise indicated.
2. Engine Generators:
- a. Specified vibration isolators are in addition to any factory-installed internal vibration isolators between generator set and integral base unless otherwise indicated; obtain generator set manufacturer approval of applied vibration isolation.
 - b. Seismic Applications: Use open (unhoused) spring isolators in combination with external seismic snubber assemblies.
 - c. Minimum Static Deflection:
 - 1) Generators Mounted on Grade-Level Slabs: 1 inch (25 mm) deflection unless otherwise indicated.
 - 2) Generators Mounted at Above-Grade Levels: 2 inch (50 mm) deflection unless otherwise indicated.
- E. Conduit Isolation:
1. Use flexible conduit or cable for electrical connections to vibration-isolated equipment, including equipment installed under other sections or by others.
 - a. Minimum Length: 3 feet (0.9 m) unless otherwise indicated.
 2. Vibration Isolators:

- a. Provide vibration isolators for conduit supports:
 - 1) Located within 50 feet (15.2 m) of connected vibration-isolated equipment where flexible connection to equipment is not possible.
 - 2) For conduits over 2 inch (53 mm) trade size located below or within 50 feet (15.2 m) of noise-sensitive areas indicated.
- b. Minimum Static Deflection:
 - 1) First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch (50 mm) deflection required.
 - 2) Remainder of Supports: 0.75 inch (19 mm) deflection unless otherwise indicated.
- c. Suspended Conduits, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
- d. Use modular seal or approved resilient material where vibration-isolated conduits penetrate building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

2.02 SEISMIC CONTROL REQUIREMENTS

- A. Design and provide electrical component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor electrical components.
- B. Seismic Design Criteria: Obtain from project Structural Engineer of Record.
- C. Component Importance Factor (I_p): Electrical components essential to life safety to be assigned a component importance factor (I_p) of 1.5 as indicated or as required. This includes but is not limited to:
 1. Electrical components required to function for life safety purposes after an earthquake.
 2. Electrical components that support or otherwise contain hazardous substances.
- D. Seismic Qualification of Equipment:
 1. Provide special certification for electrical equipment furnished under other sections and assigned a component importance factor (I_p) of 1.5, certifying that equipment will remain operable following a design level earthquake.

2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
 3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- E. Seismic Restraints:
1. Provide seismic restraints for electrical components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
 2. Seismic Restraint Exemptions:
 - a. Conduit, Cable Tray, and Raceway Exemptions, All Seismic Design Categories:
 - 1) Raceways with component importance factor (I_p) of 1.0 where flexible connections are provided between cable tray or raceway and associated components, where cable tray or raceway is positively attached to the structure, and where one of the following apply:
 - a) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 3/8 inch (10 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds (445 N) or less.
 - b) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 200 pounds (890 N) or less.
 - c) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 24 inches (610 mm) in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds (445 N) or less.
 - d) Hanger supported conduits, cable trays, or raceways with individual rod hangers 3/8 inch (10 mm) or 1/2 inch (13 mm) in diameter not exceeding

12 inches (305 mm) in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds (220 N) or less.

- 2) Conduits less than 2-1/2 inch (64 mm) trade size.
- b. Lighting Exemptions, All Seismic Design Categories:
 - 1) Suspended luminaires where attachments are designed to accommodate 1.4 times the operating weight acting in both the vertical and horizontal directions and connections to structure allow for 360 degree range of motion in the horizontal plane; arrange to prevent impact between luminaires and the structure or other nonstructural components.
 - 2) Lay-in luminaires weighing less than 56 pounds (25 kg) secured to ceiling grid and provided with safety wires in accordance with ASTM E580/E580M.
3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
 - a. ASHRAE (HVACA).
 - b. FEMA 413.
 - c. FEMA E-74.
 - d. SMACNA (SRM).
4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
5. Seismic Type Vibration Isolators:
 - a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
6. External Seismic Snubber Assemblies:
 - a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
 - b. Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.

7. Seismic Restraint Systems:

- a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
- b. Use only cable restraints to restrain vibration-isolated electrical components, including distributed systems.
- c. Use only one restraint system type for a given electrical component or distributed system (e.g., conduit, cable tray) run; mixing of cable and rigid restraints on a given component/run is not permitted.
- d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain electrical component in all lateral directions; consider bracket geometry in anchor load calculations.
- e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported electrical component weight.
- f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported electrical component weight.
- g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
- h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
- i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.

F. Seismic Attachments:

1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.

3. Do not use power-actuated fasteners.
 4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
 5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
 6. Concrete Housekeeping Pads:
 - a. Increase size of pad as required to comply with anchor requirements.
 - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.
- G. Seismic Interactions:
1. Include provisions to prevent seismic impact between electrical components and other structural or nonstructural components.
 2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
 3. Comply with minimum clearance requirements between electrical equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.
- H. Seismic Relative Displacement Provisions:
1. Use suitable fittings or flexible connections to accommodate:
 - a. Relative displacements at connections between components, including distributed systems (e.g., conduit, cable tray); do not exceed load limits for equipment utility connections.
 - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
 - c. Design displacements at seismic separations.
 - d. Anticipated drifts between floors.

2.03 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

- A. Manufacturers:

1. Vibration-Isolated Equipment Support Bases:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
 3. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Vibration-Isolated Structural Steel Bases:
1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
- C. Vibration-Isolated Concrete Inertia Bases:
1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
 2. Minimum Base Depth: 6 inches (152 mm).
 3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
 4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
 5. Concrete: Filled on site with minimum 3000 psi (20 mPa) concrete in accordance with Section 03 30 00.

2.04 VIBRATION ISOLATORS

- A. Manufacturers:
1. Vibration Isolators:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.

3. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. General Requirements:
1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
 2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
 - f. Selected to function without undue stress or overloading.
 3. Seismic Snubbing Elements for Seismic Isolators:
 - a. Air Gap: Between 0.125 inches (3 mm) and 0.25 inches (6 mm) unless otherwise indicated.
 - b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch (6 mm) thick; capable of being visually inspected for damage and replaced.
- C. Vibration Isolators for Seismic Applications:
1. Resilient Material Isolator Mounts, Seismic:
 - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
 2. Restrained Spring Isolators, Seismic:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for

seismic applications with integral snubbing in all directions.

- b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
 - d. Provides constant free and operating height.
3. Resilient Material Isolator Hangers, Seismic:
- a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
4. Spring Isolator Hangers, Seismic:
- a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
- a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

2.05 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

A. Manufacturers:

1. External Seismic Snubber Assemblies:

- a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. Vibration Eliminator Company, Inc: www.vec-co-nyc.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.
 3. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.
- C. Seismic Snubbing Elements:
1. Air Gap: Between 0.125 inches (3 mm) and 0.25 inches (6 mm) unless otherwise indicated.
 2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch (6 mm) thick; capable of being visually inspected for damage and replaced.

2.06 SEISMIC RESTRAINT SYSTEMS

- A. Manufacturers:
1. Seismic Restraint Systems:
 - a. AFCON, a brand of Anvil International; _____: www.anvilintl.com/#sle.
 - b. Eaton Corporation; _____: www.eaton.com/#sle.
 - c. Kinetics Noise Control, Inc; _____: www.kineticsnoise.com/#sle.
 - d. Mason Industries; _____: www.mason-ind.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
 3. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.
- B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

- C. Cable Restraints:
 - 1. Comply with ASCE 19.
 - 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
 - 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
 - 4. Use protective thimbles for cable loops where potential for cable damage exists.
- D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 01 45 33 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
 - 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 - 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:
 - 1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with certificate of compliance.

2. Verification of required clearances between electrical equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.
- D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install products in accordance with applicable requirements of NECA 1 (general workmanship).
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Secure fasteners according to manufacturer's recommended torque settings.
- E. Install flexible conduit and cable connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- F. Vibration Isolation Systems:
 1. Vibration-Isolated Equipment Support Bases:
 - a. Provide specified minimum clearance beneath base.
 2. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.
 - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
 3. Isolator Hangers:
 - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.

- b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
 4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
 5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
 6. Adjust isolators to be free of isolation short circuits during normal operation.
 7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
- G. Seismic Controls:
 1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris or other obstructions.
 2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
 3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch (3 mm), use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch (3 mm) or less.
 4. Equipment with Sheet Metal Housings:
 - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
 - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
 - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
 5. Concrete Housekeeping Pads:
 - a. Size in accordance with seismic design to meet anchor requirements.
 - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
 6. Seismic Restraint Systems:

- a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
- b. Install restraints within permissible angles in accordance with seismic design.
- c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
- d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
- e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Vibration Isolation Systems:
 1. Verify isolator static deflections.
 2. Verify required clearance beneath vibration-isolated equipment support bases.
 3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- D. Seismic Controls:
 1. Verify snubbing element air gaps.
- E. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS**PART 1 GENERAL****1.01 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.

1.02 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 05 36 - Cable Trays for Electrical Systems: Additional identification requirements for cable tray systems.
- E. Section 26 05 73 - Power System Studies: Arc flash hazard warning labels.
- F. Section 26 27 26 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.
- G. Section 26 31 00 - Photovoltaic Collectors: Additional identification requirements for photovoltaic systems.
- H. Section 27 10 00 - Structured Cabling: Identification for communications cabling and devices.

1.03 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs 2011.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011.

- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 969 - Marking and Labeling Systems Current Edition, Including All Revisions.

1.04 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.

1.05 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. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.07 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 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. Switchgear, Switchboards, Motor Control Centers:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location.
 - 4) Use identification nameplate to identify main and tie devices.
 - 5) Use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.

- b. Panelboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location.
 - 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. Identify spares and spaces using an identification label.

- c. Transformers:
 - 1) Identify kVA rating.
 - 2) Identify voltage and phase for primary and secondary.
 - 3) Identify power source and circuit number. Include location.
 - 4) Identify load(s) served. Include location when not within sight of equipment.

- d. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location.

- 3) Identify load(s) served. Include location.
 - e. Time Switches:
 - 1) Identify load(s) served and associated circuits controlled. Include location.
 - f. Enclosed Contactors:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
 - 4) Identify coil voltage.
 - 5) Identify load(s) and associated circuits controlled. Include location.
 - g. Centralized Emergency Lighting Inverters:
 - 1) Identify input and output voltage and phase.
 - 2) Identify power source and circuit number for normal power source. Include location.
 - 3) Identify load(s) served. Include location.
 - h. 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.
 - 3) Identify load(s) served. Include location.
 - 4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.
 - i. Electricity Meters:
 - 1) Identify load(s) metered.
2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.

- b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
 3. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
 4. Use identification nameplate or identification label to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
 5. Use identification label on inside of door at each fused switch to identify required NEMA fuse class and size.
 6. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
 7. 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.
 8. 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.
 9. Arc Flash Hazard Warning Labels: Comply with Section 26 05 73.
- 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 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.
 - d. In cable tray, at maximum intervals of 20 feet (6.1 m).
 5. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
 6. Use underground warning tape to identify direct buried cables.
- 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 color-coded bands or factory painted conduit to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet (6.1 m).
 - a. Factory painted conduit may be used to identify conduit systems:
 - 1) Emergency Power systems: Red
 - a) Life Safety Branch: Red.
 - b) Critical Branch: Green.
 - c) Equipment Branch: Green with a conduit marker "EQ" every 20 feet.
 - 2) Fire Alarm systems: Red with a conduit marker "FA" every 20 feet.
 - 3) Data/Communications/Video/Low Voltage systems: Blue
 - 4) Security Access Control/Intrusion Detection/Security Video: Purple

- 5) Fiber Optic conduit: Orange
 - b. Color-Coded Bands: Use field-painting to mark bands 3 inches (76 mm) wide. See conduit color codes above.
 - 1) Field-Painting: Comply with Section 09 91 23 and 09 91 13.
 3. Use identification labels, handwritten text using indelible marker, 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 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 Cable Tray: Comply with Section 26 05 36.
- E. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
 2. Use 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.
 - b. For exposed boxes in public areas, do not color code.
 3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
 - a. For exposed boxes in public areas, provide identification on inside face of cover.
 4. Use warning labels to identify electrical hazards for boxes containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
- F. 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 to identify serving branch circuit for all receptacles.
 - a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
 6. Use identification label 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.
- G. Identification for Luminaires:
1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.
- H. Identification for Photovoltaic Systems: Comply with Section 26 31 00

2.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
1. Manufacturers:
 - a. Brady Corporation
 - b. Brimar Industries, Inc: www.brimar.com/#sle.
 - c. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - d. Seton Identification Products: www.seton.com/#sle.
 - e. 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. Brother International Corporation: www.brother-usa.com/#sle.
 - c. Panduit Corp: www.panduit.com/#sle.
 - d. Seton Identification Products.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - a. For exterior applications, use labels listed for outdoor use.
 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. Equipment designation or other approved description.
 3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height:
 - a. Equipment Designation: 1/2 inch (13 mm).
5. Color:
 - a. Normal Power System: White text on black 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.
 - a. Include voltage and phase for other than 120 V, single phase circuits.
 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.

2.03 WIRE AND CABLE MARKERS

- A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
 2. HellermannTyton: www.hellermanntyton.com/#sle.
 3. Panduit Corp: www.panduit.com/#sle.
 4. Seton Identification Products
 5. 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.
- F. Minimum Text Height: 1/8 inch (3 mm).
- G. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradyid.com/#sle.
 - 2. Brimar Industries, Inc: www.brimar.com/#sle.
 - 3. Seton Identification Products: www.seton.com/#sle.
 - 4. 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.

- F. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

- A. 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.
- B. Legend: Type of service, continuously repeated over full length of tape.
- C. 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.

2.06 FLOOR MARKING TAPE

- A. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlamine, 3 inches (76 mm) wide, with alternating black and white stripes.

2.07 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 - 1. Materials:
 - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
 - b. 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.
- C. 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.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 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.

3.03 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

**SECTION 26 05 73
POWER SYSTEM STUDIES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Short-circuit study.
- B. Protective device coordination study.
- C. Arc flash and shock risk assessment.
 - 1. Includes arc flash hazard warning labels.
- D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 53 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.
- B. Section 26 21 00 - Low-Voltage Electrical Service Entrance.
- C. Section 26 24 13 - Switchboards.
- D. Section 26 24 16 - Panelboards.
- E. Section 26 28 13 - Fuses.
- F. Section 26 28 16.13 - Enclosed Circuit Breakers.
- G. Section 26 28 16.16 - Enclosed Switches.
- H. Section 26 29 13 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

- A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011.
- B. IEEE 141 - IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants 1993 (Reaffirmed 1999).
- C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems 2001, with Errata (2003).

- D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis 1997.
- E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems 2006.
- F. IEEE 1584 - IEEE Guide for Performing Arc Flash Hazard Calculations - Includes 1584, 1584A and 1584B 2002 (Amended 2011).
- G. NEMA MG 1 - Motors and Generators 2014.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2013.
- I. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. NFPA 70E - Standard for Electrical Safety in the Workplace 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
 - 2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Submit study reports prior to or concurrent with product submittals.
 - 2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.
 - 3. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Study preparer's qualifications.
- C. Study reports, stamped or sealed and signed by study preparer.

- D. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
 - 1. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 - 2. Identify modifications made in accordance with studies that:
 - a. Can be made at no additional cost to Owner.
 - b. As submitted will involve a change to the contract sum.
- E. Site-specific arc flash hazard warning labels.
- F. Field quality control reports.
- G. Certification that field adjustable protective devices have been set in accordance with requirements of studies.
- H. Project Record Documents: Revise studies as required to reflect as-built conditions.
 - 1. Include hard copies with operation and maintenance data submittals.
 - 2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.06 POWER SYSTEM STUDIES

- A. Scope of Studies:
 - 1. Perform analysis of new electrical distribution system as indicated on drawings.
 - 2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
 - 3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
- B. General Study Requirements:
 - 1. Comply with NFPA 70.
 - 2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C. Data Collection:

1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
 - a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
 - 1) Obtain up-to-date information from Utility Company.
 - b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
 - c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
 - d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
 - e. Protective Devices:
 - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
 - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
 - f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
 - g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.

D. Short-Circuit Study:

1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
 - a. Maximum utility fault currents.

- b. Maximum motor contribution.
 - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
 3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.
- E. Protective Device Coordination Study:
 1. Comply with applicable portions of IEEE 242 and IEEE 399.
 2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
 3. Analyze protective devices and associated settings for suitable margins between time-current curves to provide adequate protection for equipment and conductors while achieving full selective coordination.
- F. Arc Flash and Shock Risk Assessment:
 1. Comply with NFPA 70E.
 2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
 3. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
 - a. Maximum and minimum utility fault currents.
 - b. Maximum and minimum motor contribution.
 - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
- G. Study Reports:
 1. General Requirements:
 - a. Identify date of study and study preparer.
 - b. Identify study methodology and software product(s) used.
 - c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.

- d. Identify base used for per unit values.
 - e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
 - f. Include conclusions and recommendations.
2. Short-Circuit Study:
- a. For each scenario, identify at each bus location:
 - 1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
 - 2) Fault point X/R ratio.
 - 3) Associated equipment short circuit current ratings.
 - b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
3. Protective Device Coordination Study:
- a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
 - b. For each graph include (where applicable):
 - 1) Partial single-line diagram identifying the portion of the system illustrated.
 - 2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
 - 3) Conductors: Damage curves.
 - 4) Transformers: Inrush points and damage curves.
 - 5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
 - 6) Motors: Full load current, starting curves, and damage curves.
 - 7) Capacitors: Full load current and damage curves.
 - c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.

- 1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
 - 2) Include ground fault pickup and delay.
 - 3) Include fuse ratings.
 - 4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
- d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.
4. Arc Flash and Shock Risk Assessment:
- a. For the worst case for each scenario, identify at each bus location:
 - 1) Calculated incident energy and associated working distance.
 - 2) Calculated arc flash boundary.
 - 3) Bolted fault current.
 - 4) Arcing fault current.
 - 5) Clearing time.
 - 6) Arc gap distance.
 - b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.

1.07 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in preparation of studies of similar type and complexity using specified computer software.
- B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.

PART 2 PRODUCTS**2.01 ARC FLASH HAZARD WARNING LABELS**

- A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
 - 1. Materials: Comply with Section 26 05 53.
 - 2. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
 - a. Include the following information:
 - 1) Arc flash boundary.
 - 2) Available incident energy and corresponding working distance.
 - 3) Site-specific PPE (personnel protective equipment) requirements.
 - 4) Nominal system voltage.

PART 3 EXECUTION**3.01 INSTALLATION**

- A. Install arc flash warning labels in accordance with Section 26 05 53.

3.02 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Provide the services of field testing agency or equipment manufacturer's representative to perform inspection, testing, and adjusting.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Adjust equipment and protective devices for compliance with studies and recommended settings.
- E. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.
- F. Submit detailed reports indicating inspection and testing results, and final adjusted settings.

3.03 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. Training: Include as part of the base bid training for Owner's personnel on electrical safety pertaining to arc flash and shock hazards.
 - 1. Use site-specific arc flash and shock risk assessment report as training reference, supplemented with additional training materials as required.
 - 2. Instructor: Representative of entity performing study.
 - 3. Location: At project site.

END OF SECTION

**SECTION 26 05 83
WIRING CONNECTIONS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 05 33.13 - Conduit for Electrical Systems.
- C. Section 26 05 33.16 - Boxes for Electrical Systems.
- D. Section 26 27 26 - Wiring Devices.
- E. Section 26 28 16.16 - Enclosed Switches.

1.03 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (R 2010).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2012.
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- 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**2.01 MATERIALS**

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Comply with NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Section 26 28 16.16 and in individual equipment sections.
- C. Wiring Devices: As specified in Section 26 27 26.
- D. Flexible Conduit: As specified in Section 26 05 33.13.
- E. Wire and Cable: As specified in Section 26 05 19.
- F. Boxes: As specified in Section 26 05 33.16.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

**SECTION 26 09 23
LIGHTING CONTROL DEVICES****PART 1 GENERAL****1.01 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 27 26 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.

1.02 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2010.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2010.
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 1472 - Solid-State Dimming Controls Current Edition, Including All Revisions.

PART 2 PRODUCTS**2.01 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.

2.02 OCCUPANCY SENSORS

- A. Manufacturers:
 - 1. nLight.
- 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. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 6. 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.
- 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. 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.
 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).
- 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. 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. Ceiling Mounted Occupancy Sensors:
 - 1. All Ceiling Mounted Occupancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - 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.
- 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.

2.03 DAYLIGHTING CONTROLS

- A. Manufacturers:
 - 1. nLight.
- 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. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.
- D. Daylighting Control Dimming Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors and with specified dimming ballasts, for both continuous dimming of compatible dimming ballasts and 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, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
2. Control Capability: Capable of controlling up to three separately programmable channels, with up to 50 ballasts per channel.
3. Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
4. Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 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.

- 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. Occupancy Sensor Locations:
 - 1. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet (1.2 m) from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- J. Daylighting Control Photo Sensor Locations:
 - 1. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
 - 2. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.
- K. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

3.04 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 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.
- E. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05 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. 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.
- D. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 COMMISSIONING

- A. See Section 01 91 13 - General Commissioning Requirements for commissioning requirements.

3.08 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

SECTION 26 21 00
LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 2 PRODUCTS

1.01 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. Products Furnished by Contractor: Comply with Utility Company requirements.

END OF SECTION

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS**PART 2 PRODUCTS****1.01 TRANSFORMERS - GENERAL REQUIREMENTS**

- A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.
- B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
 - 1. Altitude: Less than 3,300 feet (1,000 m).
 - 2. Ambient Temperature:
 - a. Greater than 10 kVA: Not exceeding 104 degrees F (40 degrees C).
 - b. Less than 10 kVA: Not exceeding 77 degrees F (25 degrees C).
- C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.
- D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.
- E. Basic Impulse Level: 10 kV.
- F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- G. Isolate core and coil from enclosure using vibration-absorbing mounts.
- H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

END OF SECTION

SECTION 26 24 16
PANELBOARDS**PART 2 PRODUCTS****1.01 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:
- C. Short Circuit Current Rating:
- D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. 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:
 - 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - 3. Fronts:
 - 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

1.02 OVERCURRENT PROTECTIVE DEVICES

END OF SECTION

**SECTION 26 25 13
LOW-VOLTAGE BUSWAYS****PART 2 PRODUCTS****1.01 BUSWAY SYSTEM**

- A. Provide new busway system consisting of all required components, fittings, devices, supports, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Prefabricated sectionalized enclosed bus assemblies and associated fittings and devices; listed and labeled as complying with UL 857.
- D. Busway General Requirements:
 - 1. Busway Type: Totally enclosed, non-ventilated; suitable for installation in any mounting orientation the busway is designed for (e.g horizontal flatwise, horizontal edgewise, vertical) without derating.
 - 2. Temperature Rise: Not exceeding 55 degrees C, when operating at continuous rated current in an ambient temperature of 104 degrees F (40 degrees C).
 - 3. Busbars and stabs to be suitably plated at all electrical contact points.
 - 4. Busbar Insulation: NEMA Class B, rated 266 degrees F (130 degrees C).
 - 5. Housing: Steel or aluminum, with manufacturer's standard finish unless otherwise indicated.
 - 6. Single-Bolt Type Joints:
 - a. Use torque-indicating bolts with visual indication that proper torque has been applied.
 - b. Bolts to be at ground potential to allow adjustment without requiring de-energizing of busway.
 - c. Designed such that tightening of joints only requires access to one side of busway.
 - d. Allows for length adjustment of plus/minus 0.125 inch (3.2 mm).
- E. Service Conditions:
 - 1. Provide busway system and associated components suitable for operation under the following service conditions without derating:

- a. Altitude: Less than 6,600 feet (2,000 m).
 - b. Ambient Temperature:
 - 1) Busway Lengths and Fittings: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).
 2. Provide busway system and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- F. Short Circuit Current Rating:

END OF SECTION

**SECTION 26 27 13
ELECTRICITY METERING****PART 2 PRODUCTS****1.01 EQUIPMENT FOR OWNER ELECTRICITY METERING**

- A. Provide microprocessor-based digital electricity metering systems including all instrument transformers, wiring, and connections necessary for measurements specified.
- B. Confirm with the Owner if it is required to establish remote internet connectivity with the owner's energy management department web server and, if confirmed the requirement, establish connectivity.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Provide electricity metering systems and associated components compatible with the equipment and associated circuits to be metered.
- E. Service Conditions: Provide electricity meters suitable for operation under the service conditions at the installed location.
- F. Enclosures:
 - 1. Where not furnished by manufacturer, provide required cabinets and enclosures in accordance with Section 26 05 33.16.
 - 2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 3. Finish: Manufacturer's standard unless otherwise indicated.
- G. Instrument Transformers:
 - 1. Comply with IEEE C57.13, where applicable.
 - 2. Select suitable ratio, burden, and accuracy as required for connected devices.
 - 3. Current Transformers: Compatible with connected meters; replace meters damaged by connection of incompatible current transformers. Provide shorting terminal blocks for connection of secondaries where applicable.
 - 4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Receptacles.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 33.16 - Boxes for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification Revision G, 2001.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2010.
- C. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2010.
- D. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (R 2010).
- E. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2012.
- F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 498 - Attachment Plugs and Receptacles Current Edition, Including All Revisions.
- H. UL 943 - Ground-Fault Circuit-Interrupters Current Edition, Including All Revisions.

1.04 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 installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.

4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

2.02 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.

2.03 RECEPTACLES

- A. 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.
 3. Hospital Grade Receptacles: Listed as complying with UL 498 Supplement SD, with green dot hospital grade mark on device face.
- B. Convenience Receptacles:
 1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.

2. Automatically Controlled Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.
 3. Weather Resistant Convenience Receptacles: Industrial 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.
 4. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
- C. 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.
 2. Weather Resistant GFCI Receptacles: Industrial 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.

PART 3 EXECUTION

3.01 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 branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 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.
- 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. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- I. Install wall switches with OFF position down.
- J. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- K. 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.
- L. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

END OF SECTION

**SECTION 26 27 33
POWER DISTRIBUTION UNITS****PART 2 PRODUCTS****1.01 POWER DISTRIBUTION UNITS**

- A. Power Distribution Unit: For data processing equipment, suitable for underfloor cable connection, providing surge protection, harmonic filters, isolation transformer, voltage regulation, and branch circuit overcurrent protective devices.
- B. Service Conditions:
 - 1. Temperature: 32 degrees F (0 degrees C) and 104 degrees F (40 degrees C).
 - 2. Humidity: Less than 95 percent humidity (non-condensing).
 - 3. Altitude: Less than 3,300 feet (1,000 meters) above sea level.
- C. Ratings:
- D. Isolation Transformer: NEMA ST 20, factory-assembled, air cooled dry type shielded isolation transformer, ratings to match unit ratings specified.
- E. Branch Circuit Panelboard: NEMA PB 1, circuit breaker type, with bus ratings to match unit capacity specified. Provide copper ground bus and double capacity neutral bus.
- F. Molded Case Circuit Breakers: Plug-in type thermal magnetic trip circuit breakers, with common trip handle for all poles; UL listed.

END OF SECTION

SECTION 26 28 13**FUSES****PART 2 PRODUCTS****1.01 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.

END OF SECTION

SECTION 26 28 16.13
ENCLOSED CIRCUIT BREAKERS**PART 2 PRODUCTS****1.01 ENCLOSED CIRCUIT BREAKERS**

- A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. 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 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
- D. Short Circuit Current Rating:
- E. Conductor Terminations: Suitable for use with the conductors to be installed.
- F. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.
- G. 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:
- H. Provide externally operable handle with means for locking in the OFF position.

1.02 MOLDED CASE CIRCUIT BREAKERS

- A. 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.
- B. Interrupting Capacity:
 - 1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

C. Conductor Terminations:

1. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

D. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

END OF SECTION

**SECTION 26 28 16.16
ENCLOSED SWITCHES**

PART 2 PRODUCTS

END OF SECTION

**SECTION 26 51 00
INTERIOR LIGHTING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.
- E. Lamps.
- F. Accessories.

1.02 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices current edition.
- B. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code) 2013-08, with 2015 Corrigendum.
- C. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits 2002 (Cor 1, 2012).
- D. IES LM-63 - IESNA Standard File Format for Electronic Transfer of Photometric Data and Related Information 2002 (Reaffirmed 2008).
- E. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products 2008.
- F. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society 2015.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction 2010.
- H. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems 2006.
- I. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems 2006.
- J. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts 2011.

- K. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility 2012.
- L. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. NFPA 101 - Life Safety Code 2015.
- N. UL 844 - Luminaires for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.
- O. UL 924 - Emergency Lighting and Power Equipment Current Edition, Including All Revisions.
- P. UL 935 - Fluorescent-Lamp Ballasts Current Edition, Including All Revisions.
- Q. UL 1029 - High-Intensity-Discharge Lamp Ballasts Current Edition, Including All Revisions.
- R. UL 1598 - Luminaires Current Edition, Including All Revisions.
- S. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
 - 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
 - 4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.04 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.
- 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, 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.
 - b. Include IES LM-79 test report upon request.
 2. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
- D. Samples:
1. Provide one sample(s) of each specified luminaire where indicated.
 2. Provide one sample(s) of each custom luminaire where indicated.
 3. Provide one sample(s) of each luminaire proposed for substitution upon request.
 4. Provide one sample(s) of each product finish illustrating color and texture upon request.
- E. Field quality control 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. 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.
 2. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.

3. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
 4. Extra Ballasts: Two percent of total quantity installed for each type, but not less than one of each type.
- I. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.05 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.

1.06 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.07 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all LED luminaires, including drivers.
- C. Provide 2-year manufacturer warranty for linear fluorescent ballasts.
- D. Provide 5-year pro-rata warranty for batteries for emergency lighting units.
- E. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.

- F. Provide 3-year full warranty for fluorescent emergency power supply units.

PART 3 EXECUTION

2.01 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.

2.02 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.

2.03 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. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- G. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.

3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
 4. Secure pendant-mounted luminaires to building structure.
 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
 7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- H. Recessed Luminaires:
1. Install trims tight to mounting surface with no visible light leakage.
 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- I. Suspended Luminaires:
1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet (1.2 m) between supports.
 4. Install canopies tight to mounting surface.
 5. Unless otherwise indicated, support pendants from swivel hangers.
- J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- K. Install accessories furnished with each luminaire.
- L. Bond products and metal accessories to branch circuit equipment grounding conductor.

- M. Air Handling Luminaires: Interface with air handling accessories furnished and installed under Section 23 36 00.
- N. Fluorescent Luminaires Controlled by Dual-Level Switching: Connect such that each switch controls the same corresponding lamps in each luminaire.
- O. Emergency Lighting Units:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
 - 2. Install lock-on device on branch circuit breaker serving units.
- P. Exit Signs:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
 - 2. Install lock-on device on branch circuit breaker serving units.
- Q. Remote Drivers: Install in accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.
- R. Identify luminaires connected to emergency power system in accordance with Section 26 05 53.
- S. Install lamps in each luminaire.
- T. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

2.04 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.

2.05 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. Air-Handling Luminaires with Air Control Blades or Heat Removal Dampers: Adjust as indicated or as required for proper airflow as directed by Architect.
- D. 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.

2.06 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.

2.07 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.

2.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

2.09 ATTACHMENTS

- A. Luminaire schedule.
- B. Luminaire cut sheets.

END OF SECTION

SECTION 27 05 28
PATHWAYS FOR COMMUNICATIONS SYSTEMS**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Boxes, enclosures, and cabinets.

1.03 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.

1.04 ACTION SUBMITTALS

- A. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of pathway groups with common supports.

PART 2 PRODUCTS**2.01 METAL CONDUITS AND FITTINGS**

- A. General Requirements for Metal Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.
- B. EMT: Comply with ANSI C80.3 and UL 797.
- C. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:
 - a. Material: Steel
 - b. Type: Setscrew and Compression.

2.02 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Description: Comply with UL 2024; flexible-type pathway, approved for plenum installation unless otherwise indicated.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.

2.03 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets:
 1. Comply with TIA-569-B.
 2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Device Box Dimensions: 5 inches square by 2-1/8 inches deep (125 mm square by 60 mm deep).
- C. Cabinets:

PART 3 EXECUTION

3.01 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
 1. Underground Conduit: RNC, direct buried.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
 2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
- C. Minimum Pathway Size: 1 inch (27 mm) trade size. Minimum size for optical-fiber cables is 1 inch (27 mm).

- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
 - 1. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.02 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways

in use.

K. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
2. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

L. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

M. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on

each side of the coupling.

- b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.04 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.05 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

END OF SECTION 270528

SECTION 27 05 29
HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL**1.01 RELATED REQUIREMENTS**

- A. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- B. Section 27 05 33.13 - Conduit for Communications Systems: Additional support and attachment requirements for conduits.
- C. Section 27 10 00 - Structured Cabling.

1.02 REFERENCE STANDARDS

- A. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition 2022.
- B. {RSTEMP#3438}BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition;2019.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2010.
- D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 101 - Life Safety Code 2015.
- F. TIA-569 - Telecommunications Pathways and Spaces 2015d, with Addendum (2016).

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- C. Installer's qualification statement.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications for Powder-Actuated Fasteners: Certified by fastener system manufacturer with current operator's license.

PART 2 PRODUCTS**2.01 SUPPORT AND ATTACHMENT COMPONENTS**

A. General Requirements:

1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. TIA-569.
 - b. NFPA 70.
 - c. Applicable building code.
 - d. Requirements of authorities having jurisdiction.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of communications 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 Every 5 Feet. 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. Conduit Supports: Straps and clamps suitable for conduit to be supported.

1. Manufacturers:
 - a. nVent; Caddy
 - b. B-Line.

2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
3. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Cable Supports: Suitable for cables to be supported, including but not limited to J-hooks, bridle rings, drive rings, and flexible harnesses/slings.
 1. Manufacturers:
 - a. nVent; Caddy: www.nvent.com/#sle.
 - b. B-Line.
 2. Applications:
 - a. Do not exceed 5 feet (1.5 m) between cable supports.
 - b. Maximum Number of Cables per Cable Support:
 - 1) J-Hooks: 24 Cables.
 - c. Allowable Cable Types:
 - 1) J-Hooks: Category 6 and Access control and video cables.
 - 2) J hook trees .
 3. Comply with TIA-569.
 4. Cable Supports Installed in Spaces Used for Environmental Air: Plenum rated; listed and labeled as complying with UL 2043, suitable for use in air-handling spaces.
 5. J-Hooks: Noncontinuous cabling support with removable top retainer clip.
 - a. Material: Use galvanized steel, factory-painted steel, or stainless steel.
 - b. Provide support surfaces with smooth, beveled edges and radius not less than minimum allowable bend radius of cables supported.
 - c. Provide multitiered J-hooks where required to support multiple cabling systems.
- D. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch (6 mm) diameter.

- b. Trapeze Support for Multiple Conduits: 3/8-inch (10 mm) diameter.
 - c. Outlet Boxes: 1/4-inch (6 mm) diameter support
- F. Anchors and Fasteners:
- 1. 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.
 - 2. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
 - 3. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 - 4. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 - 5. Hollow Masonry: Use toggle bolts.
 - 6. Hollow Stud Walls: Use toggle bolts.
 - 7. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 - 8. 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.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1, BICSI ITSIMM, and {RS#3438}.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. 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. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners in accordance with manufacturer's recommended torque settings.
- J. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- B. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

**SECTION 27 10 00
STRUCTURED CABLING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Communications system design requirements.
- B. Communications pathways.
- C. Copper cable and terminations.
- D. Communications equipment room fittings.
- E. Communications outlets.
- F. Communications grounding and bonding.
- G. Communications identification.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 1. Includes intersystem bonding termination.
 - 2. Includes bonding jumpers for bonding of communications systems and electrical system grounding.
- C. Section 26 05 33.13 - Conduit for Electrical Systems.
- D. Section 26 05 36 - Cable Trays for Electrical Systems.
- E. Section 26 05 33.16 - Boxes for Electrical Systems.
- F. Section 26 05 53 - Identification for Electrical Systems: Identification products.
- G. Section 26 27 26 - Wiring Devices.
- H. Section 27 05 28 -
- I. Section 27 05 29 - Hangers and Supports for Communications Systems.
- J. Section 27 05 33.13 - Conduit for Communications Systems.

1.03 REFERENCE STANDARDS

- A. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition 2019.
- B. EIA/ECA-310 - Cabinets, Racks, Panels, and Associated Equipment 2005e.
- C. ICEA S-83-596 - Indoor Optical Fiber Cable 2021.
- D. ICEA S-90-661 - Category 3 and 5E Individually Unshielded Twisted Pairs, Indoor Cables (With or Without an Overall Shield) for Use in General Purpose and LAN Communication Wiring Systems 2021.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set 2020.
- G. TIA-568.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards 2018d, with Addenda (2020).
- H. TIA-569 - Telecommunications Pathways and Spaces 2019e.
- I. TIA-606 - Administration Standard for Telecommunications Infrastructure 2021d.
- J. TIA-607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises 2019d.
- K. UL 444 - Communications Cables Current Edition, Including All Revisions.
- L. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers Current Edition, Including All Revisions.
- M. UL 1863 - Communications-Circuit Accessories Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate requirements for service entrance and entrance facilities with Communications Service Provider.
 - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for communications equipment.
 - 3. Coordinate arrangement of communications equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding, prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
- C. Evidence of qualifications for installer.
- D. Field Test Reports.
- E. Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
 1. Record actual locations of outlet boxes and distribution frames.
 2. Show as-installed color coding, pair assignment, polarization, and cross-connect layout.
 3. Identify distribution frames and equipment rooms by room number on drawings.

1.06 QUALITY ASSURANCE

- A. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- B. Installer Qualifications: A company having at least 3 years experience in the installation and testing of the type of system specified, and:
 1. Employing a BICSI Registered Communications Distribution Designer (RCDD).
 2. Supervisors and installers factory certified by manufacturers of products to be installed.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

- A. Provide a complete permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.
 1. Comply with TIA-568 (SET) (cabling) and TIA-569 (pathways) (commercial standards).

2. Provide fixed cables and pathways that comply with NFPA 70 and TIA-607 and are UL listed or third party independent testing laboratory certified.
 3. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F (0 to 60 degrees C) at relative humidity of 0 to 95 percent, noncondensing.
 4. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.
- B. Main Distribution Frame (MDF): Centrally located support structure for terminating horizontal cables that extend to telecommunications outlets, functioning as point of presence to external service provider.
1. Locate main distribution frame as indicated on the drawings.
 2. Capacity: As required to terminate all cables required by design criteria plus minimum 25 percent spare space.
- C. Intermediate Distribution Frames (IDF): Support structures for terminating horizontal cables that extend to telecommunications outlets.
1. Locate intermediate distribution frames as indicated on the drawings.
- D. Backbone Cabling: Cabling, pathways, and terminal hardware connecting intermediate distribution frames (IDF's) with main distribution frame (MDF), wired in star topology with main distribution frame at center hub of star.
- E. Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

2.02 PATHWAYS

- A. Conduit: See section 27 05 33.13.
- B. Cable Trays: See Section 26 05 36.
- C. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
 1. Products:

2.03 COPPER CABLE AND TERMINATIONS

- A. Copper Backbone Cable:

1. Description: 100 ohm, balanced twisted pair cable complying with TIA-568.2, ICEA S-90-661, and listed and labeled as complying with UL 444; arranged in 25-pair binder groups.
 2. Cable Type: TIA 568.2D Cat 6 - 4 pair cable.
 3. Cable Capacity: Quantity of pairs as indicated on drawings.
 4. Cable Applications:
 - a. Plenum Applications: Use listed NFPA 70 Type CMP plenum cable.
 - b. Riser Applications: Use listed NFPA 70 Type CMR riser cable or Type CMP plenum cable.
- B. Copper Horizontal Cable:
1. Description: 100 ohm, balanced twisted pair cable complying with TIA-568.2 and listed and labeled as complying with UL 444.
 2. Cable Type - Data: TIA-568.2 Category 6 UTP (unshielded twisted pair); 23 AWG.
 3. Cable Capacity: 4-pair.
 4. Cable Applications: Use listed NFPA 70 Type CMP plenum cable unless otherwise indicated.
 5. Cable Applications:
 - a. Plenum Applications: Use listed NFPA 70 Type CMP plenum cable.
 - b. Riser Applications: Use listed NFPA 70 Type CMR riser cable or Type CMP plenum cable.
 - c. General Purpose Applications: Use listed NFPA 70 Type CM/CMG general purpose cable, Type CMR riser cable, or Type CMP plenum cable.
 6. Cable Jacket Color - Voice and Data Cable: Blue.
- C. Copper Cable Terminations: Insulation displacement connection (IDC) type using appropriate tool; use screw connections only where specifically indicated.
- D. Jacks and Connectors: Modular RJ-45, non-keyed, terminated with 110-style insulation displacement connectors (IDC); high impact thermoplastic housing; suitable for and complying with same standard as specified horizontal cable; UL 1863 listed.
1. Performance: 500 mating cycles.

2. Voice and Data Jacks: 8-position modular jack, color-coded for both T568A and T568B wiring configurations.
 3. Product(s):
 - a. any manufacturer or combination of manufacturers solution that has a min 20 year link warrentee.
- E. Copper Patch Cords:
1. Description: Factory-fabricated 4-pair cable assemblies with 8-position modular connectors terminated at each end.
 2. Patch Cords for Patch Panels:
 - a. Quantity: One for each pair of patch panel ports.
 - b. Length: Contractor to provide various lengths

2.04 COMMUNICATIONS EQUIPMENT ROOM FITTINGS

- A. Equipment Frames, Racks and Cabinets:
1. Component Racks: EIA/ECA-310 standard 19 inch (482.6 mm) wide.
 2. Wall Mounted Cabinets: Front doors with locks, louvered side panels, top and bottom cable access, and ground lug. Middle Atlantic DWR 35-26
 - a. Roof mounted fan, capacity Middle Atlantic UQFP-4.
 - b. Duplex AC power outlet inside cabinet.
 3. Cabinets: Steel construction with corrosion resistant finish.
 4. Locks: Keyed alike.
 5. Product(s):
 - a. Legrand DWR series or equivalent.
- B. Cable Management:

2.05 COMMUNICATIONS OUTLETS

- A. Outlet Boxes: Comply with Section 26 05 33.16.
1. Provide depth as required to accommodate cable manufacturer's recommended minimum conductor bend radius.

2. Minimum Size, Unless Otherwise Indicated:
 - a. Data or Combination Voice/Data Outlets: 4 inch square by 2-1/8 inch deep (100 by 54 mm) trade size.
- B. Wall Plates:
 1. Comply with system design standards and UL 514C.
 2. Accepts modular jacks/inserts.
 3. Capacity:
 - a. Data or Combination Voice/Data Outlets: 2 ports per plate.
 4. Wall Plate Material/Finish - Flush-Mounted Outlets: Match wiring device and wall plate finishes specified in Section 26 27 26.

2.06 GROUNDING AND BONDING COMPONENTS

- A. Comply with TIA-607.
- B. Comply with Section 26 05 26.

2.07 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Comply with latest editions and addenda of TIA-568 (SET) (cabling), TIA-569 (pathways), TIA-607 (grounding and bonding), BICSI N1, NFPA 70, and SYSTEM DESIGN as specified in PART 2.
- B. Comply with Communication Service Provider requirements.
- C. Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.
- D. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

3.02 INSTALLATION OF PATHWAYS

- A. Install pathways with the following minimum clearances:

1. 48 inches (1220 mm) from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
 2. 12 inches (300 mm) from power conduits and cables and panelboards.
 3. 5 inches (125 mm) from fluorescent and high frequency lighting fixtures.
 4. 6 inches (150 mm) from flues, hot water pipes, and steam pipes.
- B. Conduit, in Addition to Requirements of Section 26 05 33.13:
- C. Outlet Boxes:
1. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of telecommunications outlets provided under this section.
 - a. Mounting Heights: Unless otherwise indicated, as follows:
 - 1) Telephone and Data Outlets: 18 inches (450 mm) above finished floor.
 - 2) Telephone Outlets for Side-Reach Wall-Mounted Telephones: 54 inches (1.4 m) above finished floor to top of telephone.
 - 3) Telephone Outlets for Forward-Reach Wall-Mounted Telephones: 48 inches (1.2 m) above finished floor to top of telephone.
 - b. Provide minimum of 24 inches (600 mm) horizontal separation between flush mounted outlet boxes installed on opposite sides of fire rated walls.
 - c. Unless otherwise indicated, provide separate outlet boxes for line voltage and low voltage devices.

3.03 INSTALLATION OF EQUIPMENT AND CABLING

- A. Cabling:
1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.
 2. Do not over-cinch or crush cables.
 3. Do not exceed manufacturer's recommended cable pull tension.
 4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.

- B. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:
 - 1. At Distribution Frames: 120 inches (3000 mm).
 - 2. At Outlets - Copper: 12 inches (305 mm).
 - 3. At Outlets - Optical Fiber: 39 inches (1000 mm).
- C. Copper Cabling:
 - 1. Category 5e and Above: Maintain cable geometry; do not untwist more than 1/2 inch (12 mm) from point of termination.
 - 2. For 4-pair cables in conduit, do not exceed 25 pounds (110 N) pull tension.
 - 3. Use T568B wiring configuration.
- D. Wall-Mounted Racks and Enclosures:
 - 1. Install to plywood backboards only, unless otherwise indicated.
 - 2. Mount so height of topmost panel does not exceed 84" above floor.
- E. Identification:
 - 1. Use wire and cable markers to identify cables at each end.
 - 2. Use manufacturer-furnished label inserts, identification labels, or engraved wallplate to identify each jack at communications outlets with unique identifier.
 - 3. Use identification nameplate to identify cross-connection equipment, equipment racks, and cabinets.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Comply with inspection and testing requirements of specified installation standards.
- C. Visual Inspection:
 - 1. Inspect cable jackets for certification markings.
 - 2. Inspect cable terminations for color coded labels of proper type.
 - 3. Inspect outlet plates and patch panels for complete labels.

D. Testing - Copper Cabling and Associated Equipment:

1. Test backbone cables after termination but before cross-connection.
2. Test backbone cables for DC loop resistance, shorts, opens, intermittent faults, and polarity between connectors and between conductors and shield, if cable has overall shield.
3. Category 5e and Above Backbone: Perform near end cross talk (NEXT) and attenuation tests.
4. Category 5e and Above Links: Perform tests for wire map, length, attenuation, NEXT, and propagation delay.

E. Final Testing: After all work is complete, including installation of telecommunications outlets, and telephone dial tone service is active, test each voice jack for dial tone.**END OF SECTION**

SECTION 28 10 00
ACCESS CONTROL**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Access control system requirements.
- B. Access control units and software.
- C. Access control point peripherals, including readers and keypads.
- D. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 08 71 00 - Door Hardware: Electrically operated door hardware, for interface with access control system.
 - 1. Includes door hardware with integral request to exit devices.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Section 26 05 33.13 - Conduit for Electrical Systems.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 27 10 00 - Structured Cabling: Data cables for access control system IP network connections.
- G. Section 28 20 00 - Video Surveillance: For interface with access control system.
- H. Section 28 31 11 - Building Intrusion Detection: For interface with access control system.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- D. UL 294 - Access Control System Units Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate the work with other installers to provide suitable door hardware as required for both access control functionality and code compliance.
2. Coordinate the placement of readers with millwork, furniture, equipment, etc. installed under other sections or by others.
3. Coordinate the work with other installers to provide power for equipment at required locations.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

- B. Preinstallation Meetings:

1. Conduct meeting with facility representative to review reader and equipment locations.
2. Conduct meeting with facility representative and other related equipment manufacturers to discuss access control system interface requirements.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Include plan views indicating locations of system components and proposed size, type, and routing of conduits and/or cables. Include elevations and details of proposed equipment arrangements. Include system interconnection schematic diagrams. Include requirements for interface with other systems.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for each system component. Include ratings, configurations, standard wiring diagrams, dimensions, finishes, service condition requirements, and installed features.
- D. Certify that proposed system design and components meet or exceed specified requirements.
- E. Manufacturer's detailed field testing procedures.
- F. Field quality control test reports.
- G. Project Record Documents: Record actual locations of system components and installed wiring arrangements and routing.

1.06 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70.
 - 2. NFPA 101 (Life Safety Code).
 - 3. The requirements of the local authorities having jurisdiction.
 - 4. Applicable TIA/EIA standards.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with access control systems of similar size, type, and complexity and providing contract maintenance service as a regular part of their business; authorized manufacturer's representative.
 - 1. Contract maintenance office located within 100 miles (160 km) of project site.
- D. Maintenance Contractor Qualifications: Same entity as installer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Access Control Units - Basis of Design: Brivo, as indicated under product descriptions below; www.brivo.com/#sle.
- B. Access Control Units - Other Acceptable Manufacturers:
 - 1. Brivo; B-ACS 6100L-E-14DKIT and B-ACS6100L-EXP or approved equal: www.brivo.com/#sle.
- C. Readers and Keypads - Other Acceptable Manufacturers:
 - 1. Brivo; Brivo TriTech B-BSPSF-B or approved equal: www.brivo.com/#sle.

- D. 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.
- E. Source Limitations: Where possible, furnish system components and accessories produced by a single manufacturer and obtained from a single supplier.

2.02 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 for 30 minutes full operation.
- C. Access Control Points:
 - 1. See article "ACCESS CONTROL POINT PERIPHERALS" below for device descriptions.
- D. Interface with Other Systems:
 - 1. Provide products compatible with other systems requiring interface with access control system.
 - 2. Interface with electrically operated door hardware as specified in Section 08 71 00.
 - a. Capable of locking/unlocking/releasing controlled doors.
 - b. Capable of receiving input from integral door hardware switches.
 - 3. Interface with video surveillance system as specified in Section 28 20 00.
- 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.

2.03 ACCESS CONTROL UNITS AND SOFTWARE

- A. Provide access control units and software compatible with readers to be connected.
- B. Access Control Cloud Services - Basis of Design: Brivo Onair; www.brivo.com/#sle.
 - 1. Capacity: Unlimited cardholders; unlimited doors, readers, and administrators; unlimited workstations; unlimited events (viewable for 365 days); 60 custom fields.

2. Communication: Supports TLS1.2+ authentication with AES256 encryption.
 3. Mobile Credentials: Supports Brivo Mobile Pass mobile application.
 - a. Standard Mode: Enables user to select from list of authorized doors; supports Brivo smart readers, other compatible readers, and doors without readers.
 - b. Magic Button: Enables automatic selection of reader closest to user; supports Brivo smart readers.
 - c. Biometric Authentication: Utilizes mobile device biometric scanning capabilities.
 4. Features: Anti-passback; text/email event notifications; elevator control (up to 118 floors per reader); mobile administration application.
- C. Access Control Unit - Basis of Design: Brivo ACS6000 Control Panel (for Brivo Onair); www.brivo.com/#sle.
1. Quantity of Credentials Supported: Unlimited when connected to Brivo Onair; 250,000 when offline.
 2. Quantity of Readers Supported: Two onboard (Wiegand or RS-485 OSDP); up to 30 total utilizing up to 14 expansion door boards.
 3. Event History: 60,000 events when offline.
 4. Inputs: Eight onboard (two door position, two request-to-exit, and four auxiliary); up to 120 total utilizing up to 14 expansion boards.
 5. Output Relays: Six onboard (two lock-switching and four auxiliary); up to 118 total utilizing up to 14 expansion boards.
 6. Communication: Ethernet or Wi-Fi; supports TLS1.2+ authentication with AES256 encryption.
 7. Products:
 - a. Model B-ACS6000-E control panel (for Brivo Onair); includes two-board chassis, main board, power supply board, battery and transformer; accommodates up to 14 expansion boards per main board.
 - b. Model B-ACS6000-DB door expansion board; eight inputs (two door position, two request-to-exit, and four auxiliary) and six outputs (two lock-switching, four auxiliary).
 - c. Model B-ACS6000-EXP expansion chassis; two-board capacity with power supply.

2.04 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. Readers and Keypads:
 - 1. General Requirements:
 - a. Provide readers compatible with credentials to be used.
 - b. Color: To be selected by Architect from manufacturer's available standard colors.
 - 2. Combination Reader Type Brivo TriTech reader - Basis of Design: Brivo Smart Readers; www.brivo.com/#sle.
 - a. Credentials Supported: Brivo Mobile Pass Bluetooth Low Energy (BLE) mobile credentials, 13.56 MHz smart card (including Mifare Classic, Ultralight, Mifare Plus, DESFire EV1, DESFire EV2), 125 kHz proximity card.
 - b. Ratings: IP55, minus 31 to 51 degrees F (minus 35 to 66 degrees C), suitable for indoor or outdoor use.
 - c. Features: Accelerometer-based tamper protection, tri-state LED light bar (red, green, amber) and buzzer.
 - d. Products:
 - 1) Model B-BSPS single gang.
 - 3. Combination Reader:
 - a. Basis of Design: Brivo.
 - b. Credentials Supported: Communicates with Bluetooth Low Energy (BLE) mobile credentials, 13.56 MHz smart cards, 125 kHz proximity cards, and near-field communication (NFC) credentials.
 - 4. Contactless Smart Card Reader Trittech:
 - a. Basis of Design: Brivo.
- D. Door Position Switches:
 - 1. Magnetic Contacts: Encapsulated reed switch(es) and separate magnet; designed to monitor opened/closed position of doors.

- E. Request to Exit Devices:
 - 1. Motion Sensors: Passive infrared.
 - a. Basis of Design Products:
 - 1) Brivo.
 - 2. Door Hardware with Integral Request to Exit Switches: Comply with Section 08 71 00.
- F. Door Locking Devices (Electric Strikes and Magnetic Locks): Comply with Section 08 71 00.

2.05 ACCESSORIES

- A. Provide components as indicated or as required for connection of access control system to devices and other systems indicated.
- B. Unless otherwise indicated, credentials to be provided by Contractor.
 - 1. Provide credentials compatible with readers and control units/software to be used.
- C. Provide cables as indicated or as required for connections between system components.
 - 1. Data Cables for IP Network Connections: Unshielded twisted pair (UTP), Cat 6 complying with Section 27 10 00.
- D. Provide end-of-line resistors (EOLR) as required for supervision of hardwired connections.
- E. Provide accessory racks/cabinets as indicated or as required for equipment mounting.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

- A. Install access control system in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Wiring Method: Unless otherwise indicated, use wiring in conduit.
 - 1. Use suitable listed cables in wet locations, including underground raceways.
 - 2. Use suitable listed cables for vertical riser applications.
 - 3. Use listed plenum rated cables in spaces used for environmental air.
 - 4. Install wiring in conduit for the following:
 - a. Where required for rough-in.
 - b. Where required by authorities having jurisdiction.
 - c. Where exposed to damage.
 - d. Where installed outside the building.
 - e. For exposed connections from outlet boxes to devices.
 - 5. Conduit: Comply with Section 26 05 33.13.
 - 6. Conceal cables unless specifically indicated to be exposed.
 - 7. Use power transfer hinges complying with Section 08 71 00 for concealed connections to door hardware.
 - 8. Cables in the following areas may be exposed, unless otherwise indicated:
 - a. Equipment closets.
 - b. Within joists in areas with no ceiling.
 - 9. Route exposed cables parallel or perpendicular to building structural members and surfaces.
 - 10. Do not exceed manufacturer's recommended maximum cable length between components.
- D. Provide grounding and bonding in accordance with Section 26 05 26.

- E. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- F. Identify system wiring and components in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. Prepare and start system in accordance with manufacturer's instructions.
- B. Program system parameters according to requirements of Owner.
- C. Test for proper interface with other systems.
- D. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
- E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.
- B. 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. Location: At project site.

3.06 PROTECTION

- A. Protect installed system components from subsequent construction operations.

3.07 MAINTENANCE

- A. Provide trouble call-back service upon notification by Owner:
 - 1. Include allowance for call-back service during normal working hours at no extra cost to Owner.

2. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

END OF SECTION

**SECTION 28 20 00
VIDEO SURVEILLANCE****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Video surveillance system requirements.
- B. Video recording and viewing equipment.
- C. Cameras.
- D. Accessories.

1.02 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 33.13 - Conduit for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 27 10 00 - Structured Cabling: Data cables for IP video surveillance system network connections.
- F. Section 28 10 00 - Access Control: For interface with video surveillance system.
- G. Section 28 31 11 - Building Intrusion Detection: For interface with video surveillance system.

1.03 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 2015.
- 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.

1.04 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.
- B. Preinstallation Meetings:
 - 1. Conduct meeting with facility representative to review camera and equipment locations and camera field of view objectives.

1.05 SUBMITTALS

- A. Shop Drawings: Include plan views indicating locations of system components and proposed size, type, and routing of conduits and/or cables. Include elevations and details of proposed equipment arrangements. Include system interconnection schematic diagrams. Include requirements for interface with other systems.
- B. Certify that proposed system design and components meet or exceed specified requirements.
- C. Evidence of qualifications for installer.
- D. Evidence of qualifications for maintenance contractor (if different entity from installer).
- E. Field quality control test reports.
- F. Project Record Documents: Record actual locations of system components and installed wiring arrangements and routing.
- G. Maintenance contracts.

1.06 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70.
 - 2. Applicable TIA/EIA standards.

- 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. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with video surveillance systems of similar size, type, and complexity and providing contract maintenance service as a regular part of their business; authorized manufacturer's representative.
 - 1. Contract maintenance office located within 100 miles (160 km) of project site.
- E. Maintenance Contractor Qualifications: Same entity as installer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NECA 303.
- B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Video Recording and Viewing Equipment:
 - 1. Bosch Security Systems; _____: www.boschsecurity.us/#sle.
- B. Cameras:
 - 1. Bosch Security Systems; _____: www.boschsecurity.us/#sle.
- C. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Source Limitations: Where possible, furnish system components and accessories produced by a single manufacturer and obtained from a single supplier.

2.02 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.
 - 1. Video Storage Capacity: Suitable for storing video from all cameras for 30 days.
- C. Cameras Required:
 - 1. See article "CAMERAS" below for product descriptions.
 - 2. Camera Type: Indoor fixed dome.
 - 3. Lens Type: Furnished with camera.
 - 4. Mounting: Recessed, ceiling.
 - 5. Camera Basis of design: Bosch Flexidome 5000I Part #F.01U.379.281:
 - 6. Camera type: Outdoor camera
 - a. Camera Type: Outdoor weather proof multi-sensor dome camera.
 - b. Basis of design: NDM-7702-AL Fixed dome 12MP 3.7-7.7mm IP66 IR FLEXIDOME multi 7000i IR
 - c. Lens Type: Furnished with camera.
 - d. Mounting: Corner pendant mount.
 - e. Accessories:
 - 1) Corner Mount bracket: Bosch NDA-U-CMT
 - 2) Pendant mount arm: NDA-UM-WMTG
 - 3) Mounting bracket. Basis of design: Bosch NDA-U-CMT Corner Mount Adapter
- D. 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.
3. Interface with intrusion detection system as specified in Section 28 31 11.
 - a. Capable of affecting camera/video operation for selected intrusion detection system events.
 - b. Capable of affecting intrusion detection system status for selected video surveillance system events.
- E. Provide products listed, classified, and labeled as suitable for the purpose intended.
- F. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B, consumer application.

2.03 VIDEO RECORDING AND VIEWING EQUIPMENT

- A. Provide video recording and viewing equipment compatible with cameras to be connected.

2.04 CAMERAS

- A. Provide cameras and associated accessories suitable for operation under the service conditions at the installed location. Provide additional components (e.g. enclosures, heaters, blowers, etc.) as required.
- B. Where not factory-installed, provide additional components (e.g. lenses, mounting accessories, etc.) as necessary for complete installation.
- C. Network (IP) Cameras:
 1. Signal-to-Noise Ratio: Not less than 50 dB.
 2. Provide the following standard features:
 - a. Automatic electronic shutter.
 - b. Automatic gain control.
 - c. Automatic white balance.
 - d. Web-based interface for remote viewing and setup.
 - e. Password protected security access.
 3. Network (IP) Thermal Camera - Basis of Design: Axis Communications Q1942 Series; Model Q1942-E (Outdoor) with 10mm lens; www.axis.com/#sle.

- a. Maximum Frame Rate: 30 fps.
 - b. Image Sensor Size: 640 x 480.
 - c. Sensitivity: NETD less than 50 mK.
 - d. Lens: 10mm; horizontal field of view of 63 degrees, near focus distance of 2.8 feet (9.2 m).
 - e. Features: Local storage, audio support (two-way), Zipstream, Power over Ethernet (PoE), IP66/IP67/NEMA 4X casing, image rotation (0, 90, 180, or 270 degrees), image stabilization, two alarm inputs/outputs.
4. Network (IP) Indoor Fixed Dome Camera Type 180 deg view:
- a. Camera Type: True day/night with IR cut filter.
 - b. Image Sensor: 1/4 inch CMOS.
 - c. Resolution: Up to 720p (1280 x 720).
 - d. Frame Rate: Up to 30 frames per second (fps) at all available resolutions.
 - e. Video Streaming: Supports two simultaneous video streams using H.264 and H.264/MJPEG compression .
 - f. Power: Power over Ethernet IEEE 802.3 or 24 VAC as indicated or as required.
 - g. Features:
 - 1) Supports alarm input/output.
 - 2) Camera tampering detection.
 - 3) Video motion detection capability.

D. Lenses:

1. Where not factory-installed, provide lenses matched to cameras and the intended application.
2. Lens Type varifocal:
 - a. Basis of Design: Bosch.
 - b. Type: Varifocal, 5 - 50 mm.
 - c. Iris Control: Auto.

- d. Focus and Zoom: Manual.
- e. Features:
 - 1) IR corrected.

2.05 ACCESSORIES

- A. Camera Enclosures: Where not factory-installed, provide camera enclosures suitable for operation under service conditions at installed location.
- B. Camera Mounting Supports: Where not factory installed, provide mounting supports necessary for installation.
- C. Provide components as indicated or as required for connection of video surveillance system to devices and other systems indicated.
- D. Provide components as indicated or as required for system power and network connections.
- E. Provide cables as indicated or as required for connections between system components.
 - 1. Data Cables for IP Network Connections: Unshielded twisted pair (UTP), Cat 6, complying with Section 27 10 00.
- F. Provide accessory racks/cabinets as indicated or as required for equipment mounting.

PART 3 EXECUTION

3.01 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 where applicable.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 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. Wiring Method: Unless otherwise indicated, use wiring in conduit.
 - 1. Use suitable listed cables in wet locations, including underground raceways.
 - 2. Use suitable listed cables for vertical riser applications.
 - 3. Install wiring in conduit for the following:
 - a. Where required for rough-in.
 - b. Where required by authorities having jurisdiction.
 - c. Where exposed to damage.
 - d. Where installed outside the building.
 - e. For exposed connections from outlet boxes to cameras.
 - 4. Conduit: Comply with Section 26 05 33.13.
- E. Provide grounding and bonding in accordance with Section 26 05 26.
- F. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- G. Identify system wiring and components in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. Prepare and start system in accordance with manufacturer's instructions.
- B. Adjust cameras to provide desired field of view and produce suitable images under all service lighting conditions.
- 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.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.
- C. 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.

3.05 PROTECTION

- A. Protect installed system components from subsequent construction operations.

3.06 MAINTENANCE

- A. Provide to Owner, a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of video surveillance system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
- B. Conduct site visit at least once every three months to perform inspection, testing, and preventive maintenance. Submit report to Owner indicating maintenance performed along with evaluations and recommendations.
- C. Provide trouble call-back service upon notification by Owner:
 - 1. Include allowance for call-back service during normal working hours at no extra cost to Owner.

END OF SECTION

SECTION 28 31 11
BUILDING INTRUSION DETECTION**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Intrusion detection system requirements.
- B. Alarm control unit.
- C. Initiating devices.
- D. Alarm notification appliances.
- E. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 08 71 00 - Door Hardware: Electrically operated locks and door holder devices to be monitored and controlled by intrusion detection system.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Section 26 05 33.13 - Conduit for Electrical Systems.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 28 10 00 - Access Control: For interface with intrusion detection system.
- G. Section 28 20 00 - Video Surveillance: For interface with intrusion detection system.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2010.
- B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 639 - Intrusion-Detection Units Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate compatibility of devices for the installed locations with work provided under other sections or by others.
 - a. Doors and Windows: See appropriate Division 8 sections.
 2. Coordinate the placement of sensors and keypads with millwork, furniture, equipment, etc. installed under other sections or by others.
 3. Coordinate the work with other installers to provide communication lines required for alarm control unit connection to central station.
 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Preinstallation Meeting: Conduct meeting with facility representative and other related equipment manufacturers to discuss intrusion detection system interface requirements.
- C. Sequencing:
1. Do not install sensors and keypads until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each system component. Include ratings, configurations, standard wiring diagrams, dimensions, finishes, service condition requirements, and installed features.
- B. Shop Drawings: Include plan views indicating locations of system components and proposed size, type, and routing of conduits and/or cables. Include system interconnection schematic diagrams. Include requirements for interface with other systems.
- C. Certify that proposed system design and components meet or exceed specified requirements.
- D. Evidence of qualifications for installer.
- E. Field quality control test reports.
- F. 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.
- G. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

- H. Maintenance contracts.
- I. Project Record Documents: Record actual locations of system components and installed wiring arrangements and routing.
- J. 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: Two for each type and size installed.

1.06 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. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with intrusion detection systems of similar size, type, and complexity and providing contract maintenance service as a regular part of their business; authorized representative of control unit manufacturer.
 - 1. Contract maintenance office located within 50 miles (80 km) of project site.
- E. Maintenance Contractor Qualifications: Same entity as installer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS**2.01 INTRUSION DETECTION SYSTEM REQUIREMENTS**

- A. Provide new intrusion detection 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. Alarm Control Unit: New addressable alarm control panel located as indicated.
- C. Interface with Other Systems:
 - 1. Provide products compatible with other systems requiring interface with intrusion detection system.
 - 2. Interface with access control system as specified in Section 28 10 00.
 - 3. Interface with video surveillance system as specified in Section 28 20 00.
 - a. Capable of activating video surveillance system and controlling camera inputs/video outputs for selected intrusion detection 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.

2.02 ALARM CONTROL UNIT

- A. Alarm Control Panel: Modular construction.
 - 1. Enclosure: Lockable; provide tamper protection.
 - 2. Power Supply:
 - a. Primary Power: 120 VAC; provide suitable transformer/power supply; supervised for loss of AC power.
 - b. Secondary Power: Standby battery; provide suitable capacity for minimum standby time required by listing requirements, applicable codes, and authority having jurisdiction, but not less than four hours; provide suitable battery charger; supervised for low battery condition; protected from accidental reversal of battery leads.
- B. Alarm Initiating Circuits: Supervised.

1. Hardwired Zones: Supports both normally closed and normally open conventional (non-addressable) initiating devices.
 2. Addressable Zones: Supports addressable initiating devices and modules using multiplexed polling loops.
- C. Alarm Notification Circuits: Supervised.
- D. Communications Interfaces: Supervised.
1. Supports system reporting to central station receivers via integral interface or accessory interface modules using:
 - a. Telephone lines.
- E. Keypads: Supervised.
- F. Peripheral Devices: Supervised; provide tamper protection.
- G. Output Relays:
1. Relay Modules: Form C relays (normally open and normally closed); provide tamper protection.
 2. Programmable to respond to system events, according to defined scheduling, or by manual activation from keypad.
- H. User Codes:
1. Each user code to be individually assignable to any defined authority level for configurable access to system features and functions.

2.03 INITIATING DEVICES

- A. Manufacturers: Same as manufacturer of alarm control units where possible.
1. Other Acceptable Manufacturers:
 - a. Brivo .
- B. General Requirements:
1. Provide devices suitable for intended application and location to be installed.
 2. Outdoor Units: Weather resistant, suitable for outdoor use.
 3. Addressable Systems:

- a. Addressable Devices: Individually identifiable by control unit.
 - b. Provide suitable addressable modules for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
- C. Contacts:
1. Listed and labeled as complying with UL 634.
 2. Magnetic Contacts: Encapsulated reed switch(es) and separate magnet; designed to monitor opened/closed position of doors or windows.
 - a. Use standard security contacts (not balanced magnetic type) unless otherwise indicated.
 - b. High Security Contacts: Balanced magnetic type; designed to activate upon attempts to defeat contact through external magnetic tampering.
 3. Contact Color: To be selected by Architect from manufacturer's available standard colors.
- D. Motion Detectors:
1. Listed and labeled as complying with UL 639.
 2. Passive Infrared (PIR) Motion Detectors: Designed to detect intruder by sensing movement of thermal energy between zones.
 3. Basis of Design Products:
 - a. Brivo.
- E. Glass Break Detectors:
1. Listed and labeled as complying with UL 639.
 2. Suitable for the glass type to be monitored.
 3. Accurately discriminates false alarms from true glass break events.
 4. Furnished with selectable sensitivity.
 5. Acoustic Glass Break Detectors: Designed to analyze ambient sound and activate upon detection of specific audio patterns representative of the sound of breaking glass.

2.04 ACCESSORIES

- A. Provide components as indicated or as required for connection of alarm control unit to devices and other systems indicated.
- B. Provide cables as indicated or as required for connections between system components.
- C. Provide end-of-line resistors (EOLR) as required for supervision of hardwired zones.

PART 3 EXECUTION**3.01 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.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Wiring Method: Unless otherwise indicated, use cables (not in conduit).
 - 1. Use listed plenum rated cables in spaces used for environmental air.
 - 2. Install wiring in conduit where required for rough-in, where required by authority having jurisdiction, and where exposed to damage.
 - 3. Conduit: Comply with Section 26 05 33.13.
 - 4. Conceal all cables unless specifically indicated to be exposed.
 - 5. Route exposed cables parallel or perpendicular to building structural members and surfaces.
- 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.

3.03 FIELD QUALITY CONTROL

- A. Prepare and start system in accordance with manufacturer's instructions.
- B. Inspection and testing to include, at a minimum:
 - 1. Test each initiating device for proper response by alarm control unit.
 - a. Test glass break detectors using only manufacturer's recommended glass break simulation test units.
 - 2. Test for proper operation of output relays.
 - 3. Test for proper interface with other systems.
- C. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.04 ADJUSTING

- A. Program system parameters according to requirements of Owner.

3.05 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.
- B. 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. Location: At project site.

3.07 PROTECTION

- A. Protect installed system components from subsequent construction operations.

3.08 MAINTENANCE

- A. Provide trouble call-back service upon notification by Owner:

1. Include allowance for call-back service during normal working hours at no extra cost to Owner.

END OF SECTION

SECTION 32 11 23**AGGREGATE BASE COURSES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Aggregate base course.
- B. Paving aggregates.

1.02 RELATED REQUIREMENTS

- A. Section 32 13 13 - Site Concrete Paving: Finish concrete surface course.
- B. Section 32 17 13 - Parking Bumpers: Concrete bumpers.

1.03 REFERENCE STANDARDS

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses; 2017.
- B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18 in.) Drop; 2018.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Materials Sources: Submit name of imported materials source.
- C. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Coarse Aggregate: Coarse aggregate, complying with State of Washington Highway Department standard.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.02 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

- A. Place aggregate in maximum 4 inch layers and roller compact to specified density.
- B. Level and contour surfaces to elevations and gradients indicated.
- C. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- D. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.04 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 32 12 16**ASPHALT PAVING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Single course bituminous concrete paving installed over existing asphalt
- B. Surface sealer.

1.02 RELATED REQUIREMENTS

- A. Section 32 17 13 - Parking Bumpers: Concrete bumpers.
- B. Section 32 17 23 - Pavement Markings.

1.03 REFERENCE STANDARDS

- A. AI MS-2 - Asphalt Mix Design Methods; 2015.
- B. AI MS-19 - Basic Asphalt Emulsion Manual; 2008.
- C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.
- D. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 2009a.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Washington Highways standard.
- B. Mixing Plant: Complying with State of Washington Highways standard.
- C. Obtain materials from same source throughout.

1.05 FIELD CONDITIONS

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Asphalt Cement: ASTM D946.
- B. Aggregate for Base Course: In accordance with State of Washington Highways standards.
- C. Aggregate for Binder Course: In accordance with State of Washington Highways standards.

2.02 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Asphalt Base Course: 3.0 to 6 percent of asphalt cement by weight in mixture in accordance with AI MS-2.
- B. Asphalt Binder Course: 4.5 to 6 percent of asphalt cement by weight in mixture in accordance with AI _____.

- C. Asphalt Wearing Course: 5 to 7 percent of asphalt cement by weight in mixture in accordance with AI MS-2.

2.03 SOURCE QUALITY CONTROL

- A. Test mix design and samples in accordance with AI MS-2.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 AGGREGATE BASE COURSE

- A. Place and compact aggregate base course.

3.03 PREPARATION - TACK COAT

- A. Apply tack coat in accordance with manufacturer's instructions.
- B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 1/3 gal/sq yd.
- C. Apply tack coat to contact surfaces of curbs, gutters and Areas of existing asphalt indicated to receive asphalt overlay in drawings.

3.04 PLACING ASPHALT PAVEMENT - SINGLE COURSE

- A. Install Work in accordance with State of _____ Highways standards.
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- D. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.05 SEAL COAT

- A. Apply seal coat to asphalt surface course in accordance with AI MS-19.

3.06 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 2 days or until surface temperature is less than 140 degrees F.

END OF SECTION

SECTION 32 13 13**SITE CONCRETE PAVING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Concrete sidewalks, integral curbs, and gutters.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 32 11 23 - Aggregate Base Courses: Crushed surfacing base course for pavements and sidewalks.
- C. Section 32 17 13 - Parking Bumpers: Precast concrete parking bumpers.
- D. Section 32 17 23 - Pavement Markings.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- C. ACI 301 - Specifications for Structural Concrete; 2016.
- D. ACI 305R - Guide to Hot Weather Concreting; 2010.
- E. ACI 306R - Guide to Cold Weather Concreting; 2016.
- F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.
- G. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.
- H. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
- I. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2020.
- J. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2020.
- K. ASTM C150/C150M - Standard Specification for Portland Cement; 2020.
- L. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2016.
- M. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019.
- N. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2019.
- O. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2018.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide data on joint filler, admixtures, and curing compound.
- C. Samples: Submit two sample panels, 12 by 12 inch in size illustrating exposed aggregate finish.
- D. Design Data: Indicate pavement thickness, designed concrete strength, reinforcement, and typical details.

PART 2 PRODUCTS**2.01 PAVING ASSEMBLIES**

- A. Concrete Sidewalks, curbs, and ADA ramps 3,000 psi 28 day concrete, 4 inches thick, buff color Portland cement, exposed aggregate finish.

2.02 FORM MATERIALS

- A. Wood form material, profiled to suit conditions.
- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751) or sponge rubber or cork (ASTM D1752).
 - 1. Thickness: 1/2 inch.

2.03 REINFORCEMENT

- A. Steel Welded Wire Reinforcement: Plain type, ASTM A1064/A1064M; in flat sheets; unfinished.

2.04 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Concrete Materials: Provide in accordance with State of Washington Department of Transportation (WSDOT) Standard Plans for Road, Bridge, and Municipal Construction (most recent edition).

2.05 ACCESSORIES

- A. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
 - 1. Material: ASTM D1751, cellulose fiber.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 SUBBASE**3.03 PREPARATION**

- A. Moisten base to minimize absorption of water from fresh concrete.

3.04 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.05 REINFORCEMENT

- A. Place reinforcement of type and height as specified by Washington Department of Transportation (WSDOT) Standard Plans for Road, Bridge, and Municipal Construction (most recent edition) for slabs-on-grade.

3.06 PLACING CONCRETE

- A. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
- B. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- C. Apply surface retarder to all exposed surfaces in accordance with manufacturer's instructions.

3.07 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Place 3/8 inch wide expansion joints at 20 foot intervals and to separate paving from vertical surfaces and other components and in pattern indicated.
 - 1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch of finished surface.
 - 2. Secure to resist movement by wet concrete.
- C. Provide scored joints.
 - 1. In pattern indicated in landscape drawings
 - 2. Between sidewalks and curbs.
 - 3. Between curbs and pavement.
- D. Saw cut contraction joints 1/8 inch wide at an optimum time after finishing. Cut 1/3 into depth of slab.

3.08 EXPOSED AGGREGATE

- A. Wash concrete surfaces to which surface retarder has been applied with clean water, and scrub with stiff bristle brush exposing aggregate to match sample panel.

3.09 FINISHING

- A. Area Paving: Exposed aggregate.
- B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch radius.
- C. Curbs and Gutters: Light broom, texture parallel to pavement direction.
- D. Inclined Vehicular Ramps: Broomed perpendicular to slope.

- E. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.10 TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
- B. Maximum Variation From True Position: 1/4 inch.

3.11 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
 - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
 - 2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
 - 3. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- B. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.
 - 1. Perform one slump test for each set of test cylinders taken.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.12 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian traffic over pavement for 7 days minimum after finishing.

END OF SECTION

SECTION 32 17 13**PARKING BUMPERS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Precast concrete parking bumpers and anchorage.

1.02 RELATED REQUIREMENTS

- A. Section 32 17 23 - Painted Pavement Markings.

1.03 REFERENCE STANDARDS

- A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.
- B. ASTM C150/C150M - Standard Specification for Portland Cement; 2020.
- C. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- D. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2017a.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- B. Product Data: Provide unit configuration, dimensions.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Parking Bumpers: Precast concrete, complying with the following:
 1. Cement: ASTM C150/C150M, Portland Type I - Normal; white color.
 2. Concrete Materials: ASTM C330/C330M aggregate, water, and sand.
 3. Reinforcing Steel: ASTM A615/A615M, deformed steel bars; unfinished, strength and size commensurate with precast unit design.
 4. Air Entrainment Admixture: ASTM C260/C260M.
 5. Concrete Mix: Minimum 5,000 psi compressive strength after 28 days, air entrained to 5 to 7 percent.
 6. Use rigid molds, constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture.
 7. Embed reinforcing steel, and drill or sleeve for two dowels.
 8. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
 9. Minor patching in plant is acceptable, providing appearance of units is not impaired.

- B. Adhesive: Epoxy type.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units without damage to shape or finish. Replace or repair damaged units.
- B. Install units in alignment with adjacent work.

END OF SECTION

SECTION 32 17 23**PAINTED PAVEMENT MARKINGS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Parking lot markings, including parking bays, handicapped symbols, and other striping shown on drawings.

1.02 RELATED REQUIREMENTS

- A. Section 32 17 13 - Parking Bumpers.

1.03 REFERENCE STANDARDS

- A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- B. FHWA MUTCD - Manual on Uniform Traffic Control Devices for Streets and Highways; U.S. Department of Transportation, Federal Highway Administration; Current Edition.

1.04 SUBMITTALS

- A. See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.
- 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. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Paint: 2 containers, 1 gallon size, of each type and color.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Line and Zone Marking Paint: MPI (APL) No. 32 Traffic Marking Paint, S.B.; color(s) as indicated.
 - 1. Parking Stalls: White.
 - 2. Handicapped Symbols: Blue.

3. Concrete Bumpers: Yellow.
4. Product: Sherwin-Williams Company: ProMar Traffic Marking Paint, TM5712/TM5713; www.sherwin-williams.com.
5. Substitutions: See Division 1 Project Administration for requirements and procedures. Refer to BID PACKAGE for these GENERAL REQUIREMENTS.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Clean surfaces thoroughly prior to installation.
 1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.
- D. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.
- E. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.
- F. Temporary Pavement Markings: When required or directed by Architect, apply temporary markings of the color(s), width(s) and length(s) as indicated or directed.
 1. After temporary marking has served its purpose, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that surface to which the marking was applied will not be damaged.
 2. At Contractor's option, temporary marking tape may be used in lieu of temporary painted marking; remove unsatisfactory tape and replace with painted markings at no additional cost to Owner.

3.03 INSTALLATION

- A. Begin pavement marking as soon as practicable after surface has been cleaned and dried.
- B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.
- C. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.
- D. Comply with FHWA MUTCD manual (<http://mutcd.fhwa.dot.gov>) for details not shown.

- E. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.
- F. Apply uniformly painted markings of color(s), lengths, and widths as indicated on drawings true, sharp edges and ends.
 - 1. Apply paint in one coat only.
 - 2. Wet Film Thickness: 0.015 inch, minimum.
 - 3. Width Tolerance: Plus or minus 1/8 inch.
- G. Parking Lot: Apply parking space lines, and other markings indicated on drawings.
 - 1. Mark the International Handicapped Symbol at indicated parking spaces.
 - 2. Hand application by pneumatic spray is acceptable.
- H. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.

3.04 DRYING, PROTECTION, AND REPLACEMENT

- A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.
- B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.
- C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.
- D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.
- E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.
- F. Replace removed markings at no additional cost to Owner.

END OF SECTION

