

PORTLAND PUBLIC SCHOOLS

AINSWORTH ELEMENTARY SCHOOL

**2425 SW Vista Ave
Portland, OR 97201**

**GYM HVAC REPLACEMENT AND
FOOTING REPAIRS**

PROJECT MANUAL

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AINSWORTH ELEMENTARY SCHOOL GYM HVAC REPLACEMENT AND FOOTING REPAIRS Portland, OR

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SUMMARY**

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. General requirements.
- B. Work covered by Contract Documents.
- C. Standard working hours/days.
- D. Delegated design requirements.
- E. Contractor use of premises.
- F. Related work by Owner or others.
- G. Asbestos survey and abatement.
- H. Owner furnished products.

1.02 GENERAL REQUIREMENTS

- A. TIME OF COMPLETION
 - 1. The work of this Contract shall be commenced on the date of written notice to proceed and shall be completed by the dates established in the Owner/Contractor Agreement, and as stipulated in the General Conditions of the Contract for Construction.
- B. LIQUIDATED DAMAGES
 - 1. The Contractor acknowledges and agrees to abide by all provisions of the General Conditions of the Contract regarding real or Liquidated Damages as it pertains to all work under this Contract.
- C. ASBESTOS FREE CERTIFICATION
 - 1. Absolutely no materials containing asbestos are to be furnished or installed as part of this Project. Ensure that no subcontractor or any of the Contractor's own forces installs any materials containing asbestos. At final closeout of the Project, provide to the Owner certification that no materials containing asbestos have been installed in the Project, and that the Project is asbestos-free as required by the State of Oregon.
- D. COORDINATION
 - 1. The Contractor is responsible for overall coordination of the Project.
 - 2. The Drawings and Specifications are arranged for convenience only and do not necessarily determine which trades perform the various portions of the Work.
 - 3. Coordinate sequence of work to accommodate agreed-upon Owner occupancy.
 - 4. Perform all necessary work to receive and/or join the work of all trades.
 - 5. Verify location of existing utilities and protect from damage.
- E. PERMITS AND FEES
 - 1. The Owner will be responsible for filing and paying for building permits and all fees associated with the building permit and system development charges.
 - 2. The Contractor will be responsible for picking up all Project permits and will have full responsibility for requirements of and payments for all trade permits (i.e. electrical, plumbing, mechanical) and all costs associated with deferred submittals. Contractor shall be responsible for coordinating installation of serving utilities and is responsible for paying for all charges associated with installation of utilities.
- F. REQUIREMENTS FOR CONTRACTOR, SUBCONTRACTORS, AND MATERIAL SUPPLIERS
 - 1. Ensure that all persons performing the Work comply with Owner's tobacco policy. Copies made available upon request.
 - 2. Contractor and Subcontractors shall refrain from contact with staff and students at all times.
 - 3. Neither the Contractor nor any of its Subcontractors of any tier shall utilize any employee at the site who has pled guilty to or been convicted of any felony crime involving the

physical neglect of a child, physical injury to or death of a child, sexual offenses against or sexual exploitation of a child, child prostitution, or other similar offenses as defined by the most current State Statutes, or similar laws of another jurisdiction. Remove from the work and work site any employee who has engaged in such actions, or who the Owner reasonable considers objectionable.

4. Without limiting the generality of the foregoing, ensure by appropriate provision in each subcontract agreement that the Contractor may remove from the work and work site any Subcontractor or Subcontractor's employee who has engaged in such action. At no change to the Contract Sum or Contract Time, remove from the work and work site any employee or other person pursuant to this Section. Failure to comply with these requirements is grounds for immediate termination of the Agreement for cause.
5. Contractor, Subcontractors and material suppliers shall be responsible for all additional requirements as indicated in the Contractor Agreement.

1.03 WORK COVERED BY CONTRACT DOCUMENTS

- A. The project consists of replacement of heating and ventilating equipment serving the gymnasium and classroom below the gymnasium, and recommended repairs to a gymnasium footing. This work will require interior core drills, extension of gas piping from the boiler room to the area of work, structural work for new rooftop equipment, roof patching and roof curbs for new rooftop equipment, and capping/removal of steam and condensate piping serving the gym and classroom below. The existing steam ventilating units serving the gymnasium and classroom will be removed. Along with the work, there will need to be coordination with a hazardous materials abatement contractor, as specified in documents prepared by G2 Consultants. A new electrical panel will be provided in the classroom with a new feed from the boiler room. The gym will be provided with a rooftop packaged gas heating unit, located on the gymnasium roof. The classroom will be provided with a split system heat pump. The indoor unit will be located exposed inside the classroom, the outdoor unit located on the gymnasium roof.

1.04 STANDARD WORKING HOURS/DAYS

- A. PPS Project Schedule assumes a 5-day work week.
- B. Exterior work may be performed Monday through Friday from 7:00 a.m. through 6:00 p.m. and Saturday from 8:00 a.m. through 4:00 p.m.
- C. Interior work that does not generate noise may be performed Monday through Friday from 7:00 a.m. through 11:00 p. m. and Saturday from 7:00 a.m. through 5:00 pm with the concurrence of the District Authorized Representative.
- D. For any deviation from the above stated working days/times, submit a request in writing to the District at least 48 hours prior to the date in question. While the District cannot assure approval in every instance, efforts will be made to accommodate such requests.

1.05 DELEGATED DESIGN REQUIREMENTS

- A. Certain components of the Work under this project are Delegated Design. It is the Contractor's responsibility to coordinate and assume or assign to subcontractors the complete responsibilities for the design, calculation, submittals, fabrication, transportation and installation of the Delegated Design portions or components as required. Delegated Design components of the Work are defined as complete operational systems, provided for their intended use.
- B. Submit deferred submittals for delegated design elements to the governing agency for the separate approval of each Delegated Design item as defined in Section 01 30 00 - Administrative Requirements.
- C. Owner shall not be responsible to pay for any delays, additional products, additional hours of work or overtime, restocking or rework required due to failure by the Contractor or the subcontractor to coordinate their work with the work of the other trades on the project or to provide the Delegated Design portion or component in a timely manner to meet the schedule of the project.

- D. Delegated Design components include, but are not limited to the following:
1. Seismic Anchorage Division 23

1.06 CONTRACTOR USE OF PREMISES

- A. Work Sequence:
1. Perform Work in a manner required to accommodate School District use of premises during the Contract Period. Coordinate Work schedules and operations with Owner's use requirements.
 2. Provide access to and from site as required by law and by Owner:
 - a. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 3. Do not obstruct roadways, sidewalks, or other public ways without permit.
- B. Limitations on Use:
1. Owner intends to occupy and conduct school in the building during portions of the construction period. The building during times of Owner occupancy is a limited Contractor access area. Coordinate access to the existing building.
 - a. Areas of Owner occupied and Contractor occupied spaces shall be clearly delineated and commingling of spaces shall not be permitted. Provide maps that clearly identify proposed use of the premises for each phase of the Work.
 2. Complete and exclusive use of the construction area except as outlined above will be permitted from Notice to Proceed until Substantial Completion of the Project. Coordinate areas available for early occupancy (if any) with Owner.
 3. During times of Owner's occupancy there may be days during the Contract Period when Owner occupied areas will be unoccupied. Request from the District a list of days that may occur during the Contract Period. Notify the District at least 48 hours in advance of down days during which time the Contractor intends to work.
 - a. Provide temporary services for essential equipment during down times.
 4. Smoking or open fires will not be permitted within the building enclosure or on the premises.
 5. Do not encumber the site with materials or equipment. Confine stockpiling of materials and location of storage sheds to the areas indicated or coordinated with Owner.
 6. Move any stored products under Contractor's control which interfere with operations of Owner or separate contractors.
- C. Contractor's Site Conduct:
1. Identifying name tags will be worn at all times.
 2. No loitering in the school buildings or unsupervised/unauthorized entry.
 3. Site is tobacco- and cannabis-free. This means no smoking or chewing on any school property.
 4. Beyond courtesy, there should be no interaction between staff and faculty.
 5. Keep project free of pop cans, lunch wrappers and similar debris.
 6. Review with the Owner the scheduling of any work that is excessively noisy or has the potential to disrupt activities of Owner or neighbors.
 7. Be considerate of the client, the students and faculty.
 8. Always consider, prior to an act, the safety of students, faculty and other co-workers.
 9. Profanity is not acceptable.
 10. The wearing of clothing with logos displaying alcohol, tobacco, illegal or restricted substances or suggestive themes is not acceptable attire.
- D. Non-Interference with School:
1. Perform work operations upon areas adjacent to existing Owner-occupied areas and/or structures in such manner as to not interfere with continued free and comfortable use of such areas.
 2. During normal school hours, keep building exits safe, protected, and restricted from remainder of construction site and clear of obstructions at all times. If closure of an exit is

required by the Work, notify the school Principal and allow ample time for an alternate exit plan to be executed.

3. Work shall not be performed in Owner-occupied areas or rooms during normal school hours when such spaces are required for school use. Such Work shall be performed after normal school hours up to 10:00 PM or as agreed upon with Owner, and if no night time school activities are planned. Work may be performed during weekends and vacation periods when school is normally closed if coordinated in advance with school administration. All Work required in rooms or spaces being utilized for school purposes must be closely scheduled with the District such that rooms or spaces may be safely used for school purposes when classes resume.
- E. Non-Interference with Serving Utilities:
1. Do not interrupt electric, gas, water, or other services to existing Owner-occupied structures without prior notice to the District and then only at a definite time and for a definite duration approved by Owner.
 - a. Disruption of utilities must be approved by the Owner. Requests must be made 72 hours prior to disruption and a plan detailing a definite start time and duration provided.
 2. Schedule demolition, remodel, and new construction to accommodate Owner's continued use of existing and/or new mechanical, electrical, and plumbing services as required for Owner's continued occupancy and beneficial use of designated areas.
 3. Consult with public and private utility companies for location and extent of all utilities before commencing work.
 4. Provide services of a utilities locator to investigate and mark underground utilities in the vicinity of exterior work; and for interior below-slab utilities in areas which will be partially demolished prior to commencing work. Ensure that utilities are identified prior to saw cutting interior floor slabs.
 5. Provide all services required. Protect and maintain existing utilities, active electrical conductors, sewers, pipes, and other active lines either on project site or in offsite street excavations.
 6. Arrange for and pay cost of disconnecting, removing, relocating, capping, replacing, or abandoning of public and private utilities in the way of construction operations in accordance with serving utilities policies, local regulations and governing codes. Utilities, pipes, sewers, electrical conductors and the like to be abandoned shall be capped in accordance with instructions of governing authority or as directed.
- F. Protections - Exterior Components:
1. Protect sidewalks, asphalt paving, concrete, plantings, and lawn areas at all times from spillage of materials used in carrying out the Work. Exercise care to preclude materials from clogging catch basins and yard drains. Leave all drainage items clean and in proper working condition.
 2. Clean, repair, resurface, or restore existing surfaces to their original condition, or completely replace such surfaces to match existing where damaged by construction operations.
 3. Whenever it is necessary to cut and remove fences and/or power lines (whether on private or public property), restore such demolished work to condition at minimum equal to that which existed prior to such demolition.
 4. Damage to property adjacent to Owner's property shall be restored to the satisfaction of respective property owners.
- G. Protections - Interior Components:
1. Contractor is responsible for protection of completed portions of the Work. Provide protection as required such that items are not soiled or damaged during the progression of the Work. Maintain all such protections for the entire duration of the construction until acceptance by Owner.
 - a. Provide a weathertight condition throughout the Work. Clean, repair, resurface or restore building and site components required to be protected to their original

- condition, or completely replace items to match existing undamaged portions of Work, where damaged by construction operations.
2. Whenever it is required and/or necessary to demolish portions of work, take all precautions to protect adjacent portions of the work which remain from damage.
 3. Keep public areas such as hallways, stairs, elevator lobbies and toilet rooms free from accumulation of waste material, rubbish or construction debris.
 4. Gather and shroud all existing furnishings to the extent needed to provide protection from construction dust.
 5. Clean, repair, resurface, or restore such items above required to be protected to their original condition, or completely replace items to match existing undamaged portions of work, where damaged by construction operations.
- H. Protections: Vegetation and Plantings:
1. Protect all existing trees to remain on-site from foliage, trunk, branch, and root damage.
 2. Provide barricades and maintain same around all trees, plantings, and other landscaped areas adjacent to work of this Contract to protect such areas from damage of any nature caused by construction operations.
 3. Replace any plantings damaged or destroyed with plants of equivalent type, size, quantity, and nature as approved by Architect.
- I. Security:
1. Provide security and facilities to protect the Work and Owner's operations from unauthorized entry, vandalism, and theft.
 2. Provide temporary barriers, doors, and locks at all openings after building is enclosed.
 3. Lock automotive vehicles and other mechanized or motorized construction equipment when parked and unattended. Do not leave vehicles or equipment unattended with the motor running or ignition key in place.
 4. Coordinate with Owner's building security provider and program.
- J. Removal of Equipment and Materials:
1. Clear site and surrounding street areas of all equipment, apparatus, appliances, tools, unused materials, and similar items immediately as they cease to be necessary to carry out the Work.

1.07 RELATED WORK BY OWNER OR OTHERS

- A. NIC and OFOI Items: Items designated on the Drawings and/or described in the Project Manual as "NIC" (Not In Contract) or "OFOI" (Owner Furnished, Owner Installed) are not included in the Contract.
- B. Contractor Responsibilities for NIC and OFOI items:
1. Designate delivery date for each portion of the Work in the Progress Schedule (if appropriate).
 2. Storage of products if requested.
 3. Coordination of installation with Project Schedule.
 4. Provide all preparatory work necessary for proper installation including but not limited to: blocking, backing, and finish work including sealing, grouting, furring, preparing subfloors for finish flooring materials, and painting adjacent surfaces as required for NIC and/or OFOI products.
- C. Work independent of the scope of the contract may be performed concurrently during the project timeline, including, but not limited to:
1. Custodial activities in areas not affected by construction.
 2. General maintenance activities.
 3. Independent contracted work within the building.
 4. Installation of Owner Furnished and/or Owner installed items.
- D. Work of the Project which will be executed concurrently with the Work of this Contract, and which is specifically excluded from this Contract:

1. Hazardous Material Abatement, including, but not limited to, Asbestos and PCB abatement.

1.08 ASBESTOS SURVEY AND ABATEMENT

- A. The Owner has furnished, at its expense, all information, requirements, reports, data, surveys and instructions required for performance of the Work of this Article. Contractor may use such information, requirements, reports, data, surveys and instructions in performing its services and is entitled to rely upon the accuracy and completeness thereof. The Architect shall not be held responsible for any errors or omissions that may arise as a result of erroneous or incomplete information provided by the Owner and/or the Owner's consultants and contractors.
- B. Employ subcontractors and others knowledgeable about asbestos abatement procedures and required safety procedures. Subcontractors on the jobsite shall take precautions when working to avoid contact with asbestos-containing components and should any material suspected of containing asbestos be discovered, work shall be discontinued and the appropriate safety procedures shall be immediately initiated. Immediately notify the Owner and the abatement consultant for assistance. Additional cost for abatement of asbestos discovered during the course of construction work shall be brought to the attention of the Owner and fully agreed upon prior to commencing additional abatement work.
- C. Costs related to asbestos abatement defined by the Asbestos Survey and Abatement documents are to be included in the Bid and entered on the Bid Form where indicated.

1.09 OWNER-FURNISHED PRODUCTS

- A. OFCI Equipment and Products: Items specifically designated on Drawings or specified in the Project Manual and/or described as "OFCI" (Owner Furnished, Contractor Installed).
- B. Owner's Responsibilities for OFCI Products:
 1. Arrange for delivery of shop drawings, product data, samples, manufacturer instructions, and certificates to Contractor.
 2. Deliver supplier's bill of materials to Architect for review.
 3. Arrange and pay for delivery to site in accordance with Contractor's Progress Schedule.
 4. Inspect deliveries jointly with Contractor.
 5. Submit claims for transportation damage.
 6. Arrange for replacement of damaged, defective, or missing items.
 7. Arrange for manufacturer's field services; arrange for and deliver manufacturer warranties and bonds to Contractor.
- C. Contractor Responsibilities for OFCI Products:
 1. Designate submittals and delivery date for each product in project Progress Schedule.
 2. Review shop drawings, product data, samples, and other submittals. Submit to Architect with notification of any observed discrepancies or problems anticipated due to non-conformance with Contract Documents.
 3. Receive and unload products at work site.
 - a. Inspect deliveries jointly with Owner, record shortages and damaged or defective items.
 - b. Handle products at site including uncrating and storage.
 - c. Protect products from damage and from exposure to elements.
 - d. Assemble, install, connect, adjust, and finish products.
 - e. Provide installation inspections required by public authorities and jurisdictions.
 - f. Repair or replace items damaged by Contractor to satisfaction of Owner.
- D. Schedule of OFCI Products and Equipment:
 1. Toilet Accessories as described in Section 10 28 00 - Toilet, Bath and Laundry Accessories.
 - a. Coordinate placement of accessories to meet accessibility requirements, clearance from grab bars and placement of backing.
 2. Residential kitchen appliances as described in Section 11 31 00 - Residential Appliances.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 13 31
CERTIFICATE OF COMPLIANCE**

No final payment shall be made until the contractor provides to the owner, prior to acceptance of the work, a notarized certification of compliance in following form:

The Contractor does hereby certify that all work has been performed and materials supplied in accordance with the drawings, specifications and Contract Documents for the above Work, and that:

No less than the prevailing rates of wages as ascertained by the governing body of the Contracting agency has been paid to laborers, workmen and mechanics employed on this Work;

There have been no unauthorized substitutes of Subcontractors; nor have any subcontracts been entered into without the names of the Subcontractors having been submitted to the Owner prior to the start of such subcontracted work;

No subcontract was assigned or transferred or performed by any Subcontractor other than the original Subcontractor, without prior notice having been submitted to the Owner together with the names of all Subcontractors;

All claims for material and labor and other service performed in connection with these specifications have been paid;

In WITNESS WHEREOF, the undersigned has signed and sealed this instrument this

_____ day of _____, _____

Firm Name: _____

Signature: _____

Title: _____

Attest _____
(Seal if Bidder is a Corporation)

As determined necessary, evidence of compliance may be required to be submitted with and made a part of this Certificate of Compliance.

END OF SECTION

SECTION 01 13 32
CERTIFICATE OF NO HAZARDOUS MATERIALS

No final payment shall be made until the Contractor shall file with the Owner, prior to acceptance of the work, a notarized certificate of no hazardous materials in the following form:

"To the best of my knowledge no hazardous material, including, but not limited to: asbestos, polychlorinated biphenyls (pcb's) and lead based products, is used in the construction of this project. Material safety data sheets will be provided as requested by the Owner for all materials which may be questioned in the future."

In WITNESS WHEREOF, the undersigned has signed and sealed this instrument this

_____ day of _____, _____

Firm name: _____

Signature: _____

Title: _____

Attest: _____

(Seal if Bidder is a Corporation)

As determined necessary, evidence of compliance may be required to be submitted with and made a part of this certificate.

END OF SECTION

SECTION 01 20 00
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Procedures for preparation and submittal of application for final payment.

1.02 RELATED REQUIREMENTS

- A. CM/GC General Conditions for Public Improvement: Progress Payments and Final Payment.
- B. Section 01 21 00 - Allowances: Payment procedures relating to allowances.
- C. Section 01 22 00 - Unit Prices: Monetary values of unit prices, payment and modification procedures relating to unit prices.
- D. Section 01 31 23 - Project Management Database (PMD).
- E. Section 01 77 00 - Closeout Procedures: Substantial Completion and Final Payment.

1.03 SCHEDULE OF VALUES

- A. Form to be used: PPS payment application form.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Owner and Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Submit Schedule of Values at times indicated in Section 01 30 00 - Administrative Requirements.
- E. Format: Utilize the format of the PPS payment application form and comply with requirements of the Owner/Contractor Agreement. Identify site mobilization and bonds and insurance. Provide closeout and punch list line items. Submit, at least ten business days prior to submission of its first application for progress payment, a schedule of values ("Schedule of Values") for the contracted Work, for the Districts' review and approval. This schedule will provide a breakdown of values for the contracted Work and will be the basis for progress payments. The breakdown will demonstrate reasonable, identifiable and measurable components of the Work. Unless objected to by the District's Authorized Representative, this schedule shall be used as the basis for reviewing CM/GC's applications for payment. If objected to by District's Authorized Representative, CM/GC shall revise the schedule of values and resubmit the same for approval of District's Authorized Representative.
 - 1. The Schedule of Values shall be of sufficient detail and organization to interface with the District's accounting and funding structure.
- F. Include in each line item, the amount of Allowances and contingency specified in the appropriate section.
- G. For items on which progress payments will be requested for stored materials, break down the cost into:
 - 1. The cost of materials (only), delivered and unloaded, with taxes and the like, paid.
 - 2. Remainder of installed value (labor, temporary facilities/equipment needed, etc.).
 - 3. Failure to provide this breakdown prior to materials being delivered voids Contractors right to be paid for affected materials until they are installed.
- H. For each line item of installed value exceeding \$20,000, show breakdown by major products or operations under each item.
- I. Round-off figures to nearest dollar amount for the original breakdown only.
- J. Make sum of total scheduled costs equal to Contract Sum.
- K. Revise schedule to list approved Change Orders, with each Application for Payment.

1.04 SUBCONTRACTOR AND SUPPLIER LISTING

- A. Subcontractor and Supplier Listing: Follow Project Manual Table of Contents as a format for listing name of Subcontractors, including lower-tier Subcontractors and suppliers.
 - 1. Identify by section number and title the company, address, telephone number and contact person.
 - 2. Adjacent to Subcontractor list its lower-tier Subcontractor(s) and/or supplier(s).

1.05 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Submit a preliminary copy of the Payment Application to Owner and Architect for comment prior to formal submittal.
- B. Submit applications for payment in accordance with General Conditions using specified forms.
 - 1. Contractor is encouraged to review the payment application draft during the progress meeting that occurs during the last week of the month.
 - 2. Payment requests must be initiated and approved using the District mandated workflow process in E-Builder.
 - a. Refer to Section 01 31 23 - Project Management Database (PMD).
- C. Payment Period: Submit at intervals stipulated in the Agreement.
- D. Form to be used: PPS Form "Application and Certificate for Payment".
- E. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- F. Forms filled out by hand will not be accepted.
- G. Lien Releases shall be submitted on District form or approved equal.
- H. Execute certification by signature of authorized officer.
 - 1. Notarized Affidavit: After the first request for payment, each subsequent request shall be accompanied by notarized affidavit stating that all subcontractors have been paid less earned retainage as their interests appeared in the last payment received. No application for payment by the Contractor shall be processed unless accompanied by such Contractor's affidavit.
 - 2. In addition, the Owner may require that any requests for payment shall also be accompanied by a receipt with original signature from the Principal Subcontractors including Mechanical and Electrical, and others as required by the Owner, of the dollar amount they received for the previous month's work (less earned retention), and an affidavit by such Subcontractors stating that all sub-subcontractors, suppliers, wages, fringes, and taxes arising out of such subcontract have been paid in full as their interest appeared in the last payment received.
- I. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
 - 1. For applications for stored materials include:
 - a. Project.
 - b. Application number and date.
 - 1) Item number and identification as shown on application and description of specific material or product.
 - 2) Material stored off-site: Record of quantities and bonding/insurance of storage facility.
 - 3) Must be within 75 driving miles of the site and open to Architect's and Owner's inspections and inventory during regular business hours.
 - c. Verification of stored materials and partial payment for such materials do not constitute acceptance on the part of the District. In the event that materials stored are found to be unsuitable for installation or incorporation into the Work for any reason, Contractor shall bear full responsibility for any and all corrections needed.

- d. District shall not be responsible for any additional costs incurred for storage of materials unless such storage is the result of and a part of an approved Change Order where the District is found to be responsible for such costs.
- J. List each authorized Change Order as a separate line item, listing Change Order number, description and dollar amount as for an original item of Work. Provide a breakdown by major products or operation for amounts in excess of \$20,000.
- K. Include the following with the application:
 - 1. Construction progress schedule, revised and current as specified in Section 01 32 00 - Construction Progress Documentation.
 - 2. Partial release of liens from major Subcontractors and vendors on District form or approved.
 - 3. Affidavits attesting to off-site stored products.
- L. Current Record Documents: Prior to acting on processing each monthly request for payment, Contractor is required to present for review to Architect and consultants, a current set of record documents indicating any revisions.
- M. Certified Statements of Intent to Pay Prevailing Wage for each trade shall be on file with the Architect and Owner prior to applying for payment of work of that trade. Where such Certified Statements are not provided, that category of work will not be paid until appropriate documentation is filed.
- N. When Architect or Owner requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.06 SPECIAL CONDITIONS OF INITIAL PAYMENT

- A. Prior to initial payment, the Contractor must have delivered all required insurance, bonds and contracts; acceptable Schedule of Values, Sub-Contractors/Suppliers List, Contractor Construction Schedule.
 - 1. Include construction waste management plan and other plans required as part of the sustainable construction procedures specified in Section 01 35 15 - LEED Certification Procedures.

1.07 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
 - 1. Submit Application for Final Payment at time indicated in Section 01 30 00 - Administrative Requirements.
- B. All Project Closeout activities must be complete, including, but not limited to, all liens and claims settled; all project record documents transmitted in final approved form; record survey (if required) transmitted and recorded by the County; removal of temporary services, facilities and all debris/materials/ equipment and all other requirements of the General Conditions. All permit drawings, sign-off sheets and Certificates of Occupancy transmitted.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for processing contract modifications and Change Orders.

1.02 RELATED REQUIREMENTS

- A. CM/GC General Conditions for Public Improvement: Governing requirements for changes in the Work, in Contract Cost, and Contract Time.
- B. Section 01 20 00 - Price and Payment Procedures: Applications for payment and Schedule of Values.
- C. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance (O&M) data, warranties and bonds.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Submit name of individual authorized to accept changes, and to be responsible for informing others in Contractor's employ of changes in the Work.
- C. All contract modifications must be initiated and approved using the District mandated workflow process in E-Builder.

1.04 GENERAL REQUIREMENTS

- A. No additional work shall be undertaken without Owner's and Architect's written approval.
- B. Written approval authorizing Contractor to undertake additional Work does not authorize automatic extension of Contract Completion time.
- C. Coordinate related requirements specified in other parts of the Project Manual including, but not limited to, General Conditions and Section 01 31 23 - Project Management Database (PMD).

1.05 DEFINITIONS

- A. Change Order (CO): This document executed by Owner, Contractor and Architect formally changes the Contract Sum, Contract Scope or Contract Time and incorporates Change Requests and/or Construction Change Directives.
- B. Change Request (CR): This document initiated by the Owner or Contractor is to be priced by the Contractor. Upon authorization by the Owner it becomes an instruction to the Contractor to modify the scope of the Contract for inclusion in a future Change Order.
- C. Architect's Supplemental Instructions (ASI): This form is a written order comprising instructions or interpretations, signed by Architect making minor changes in the Work not involving a change in Contract Sum or Contract Time. If the Contractor considers that the ASI constitutes a Change in the Work, it must notify the Owner in accordance with the Contract Documents.
- D. Construction Change Directive (CCD): A written order to the Contractor, by the Owner, amending Contract Documents as described. This order directs Contractor to proceed with Work that may alter Contract Sum and/or Contract Time, and is intended to be included in a subsequent Change Request pending agreement on changes in the Contract Sum and/or Contract Time. The Owner will include a not-to-exceed value for the proposed CR process in the CCD.

1.06 SIGNATURES

- A. All signatures on Change Orders and Construction Change Directives shall be original scanned signatures. Electronically inserted signatures, electronically stamped signatures and digital signatures are not acceptable. Scanned copies of signatures are acceptable but the scan must be legible.

1.07 MODIFICATION PROCEDURES

- A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
 - 1. Form for Minor Changes in the Work: Architect's "Architect's Supplemental Instructions" form.
 - 2. If Contractor determines that an Architect's Supplemental Instruction involves adjustments to the Contract Sum or Contract Time, Contractor shall prepare and issue a Change Request to the Architect and Owner for approval prior to proceeding with the Architect's Supplemental Instruction.

1.08 DOCUMENTATION OF CHANGE IN CONTRACT SUM AND CONTRACT TIME

- A. Maintain detailed records of work performed on a time and materials basis. Provide complete information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.
- B. Document each quotation for a change in cost or time with sufficient data to allow evaluation of the quotation.
- C. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
- D. Provide additional data to support computations including:
 - 1. Quantities of products, labor, and equipment.
 - 2. Taxes, insurance, and bonds.
 - 3. Overhead and profit.
 - 4. Justification for any change in Contract Time.
 - 5. Credit for deletions from Contract, similarly documented.
- E. Support each claim for additional costs, and for work performed on a time and materials basis with the following information:
 - 1. Origin and date of claim.
 - 2. Dates and times work was performed, and by whom.
 - 3. Time records and wage rates paid.
 - 4. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
 - 5. Follow all other requirements indicated in the Owner-Contractor Agreement.

1.09 PROPOSED CHANGE PROCEDURES

- A. For changes for which advance pricing is desired, Owner will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications. Contractor shall prepare and submit a fixed price quotation within 14 days.
 - 1. Form for Change Requests: Owner's "Change Request" form, e-Builder.
 - 2. Form for Fixed Price Quotation: Electronically submitted PDF via e-Builder.
- B. If latent or unforeseen condition require modifications to the Contract, or if an RFI response or an Architect's Supplemental Instruction is determined to have cost or schedule impacts, Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors. Document any requested substitutions in accordance with Section 01 60 00.
 - 1. Form for Proposal Requests: Owner's "Change Request" form via e-Builder.
 - 2. Form for Fixed Price Quotation: Electronically submitted PDF.
- C. Change Request Log: Log will be maintained in e-Builder which will automatically assign numbers to process. However, the Contractor may add their Contractor CR number for tracking purposes.

1.10 APPROVAL OR REJECTION OF CHANGE REQUEST

- A. When a proposed change is initiated through a Change Request:
 - 1. Submit the following in writing within seven (7) days of date on Proposal Request:

- a. All allowable direct and indirect costs.
 - b. Schedule of Values and Unit Prices including basis for costs.
 - c. Quotation will be guaranteed for period specified in the CR beginning from signing of proposal, but, as a minimum, 30 days. If no period is specified, quotation shall be guaranteed for sixty (60) days from signing.
 - d. Proposal shall be approved by authorized person.
 - e. Failure of the Contractor to respond with pricing in a timely manner shall not be justification for claims by the Contractor of delay of the project associated with the Change.
2. Architect, CM and Owner will review proposal and respond in writing by one of the following:
 - a. Authorizing.
 - b. Requesting additional information.
 - c. Rejecting.
 3. Authorization to proceed with Change through a recommendation by the Architect to the Owner and written authorization by the Owner directs Contractor to undertake Work.
- B. When Change is initiated by Contractor:
1. Architect and Owner review and respond in writing (via e-Builder process) by one of the following:
 - a. Processing a Change Order or Proposal.
 - b. Requesting additional information.
 - c. Rejecting.
 2. If Owner responds by processing a Change Request, follow procedure outlined above.
 3. If additional information is requested by Owner, respond in writing within seven days of Owner's request.

1.11 DOCUMENTATION OF PROPOSALS AND CLAIMS

- A. Support each lump sum proposal quotation and each unit price (not previously established) with detailed substantiating data. Clearly cross reference tracking numbers of CCDs, RFIs, CRs, etc. to allow easy identification of costs origins
1. Include as separate line items any changes related to credits to Contract Sum or Contract Time associated with not performing the originally specified Work.
- B. On request, provide additional data to support time and cost computations:
1. Labor hours, number of workers, time cards and hourly rate cost justification
 2. Equipment hours, make and model, number of pieces required, rental agreements and hourly rate justification.
 3. Products required.
 - a. Recommended source of purchase and unit cost.
 - b. Quantities required.
 4. Documented credit for Work deleted from Contract.
 5. Justification citing specifics of critical path impacts per current CPM for any change in Contract Time.
- C. Support each claim for additional costs, and time-and-material/force account work with documentation, as required for lump-sum proposal. Include additional information:
1. Name of Owner's authorized agent who ordered work, and date of order.
 2. Dates and times work was performed and by whom.
 3. Time record, summary of hours worked and wage rates paid.
 4. Receipts and invoices for:
 - a. Equipment used, listing dates and times of use.
 - b. Products used, listing of quantities.
 - c. Subcontracts.

1.12 CONSTRUCTION CHANGE DIRECTIVES

- A. For changes that involve an adjustment to the Contract Sum or Contract Time, Owner will issue a document instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 - 2. Promptly execute the change.
 - 3. Form for Construction Change Directives: Architect's "Construction Change Directive" form via e-Builder.

1.13 FIXED PRICE CHANGE ORDER

- A. Base upon Owner's Change Request and Contractor's fixed price quotation; or Contractor's request for Change Order as approved by Architect and Owner.
- B. Change Order describes Work changes, additions and deletions, with attachments of authorized Proposal Requests, agreed Construction Change Directives and/or previously agreed upon change pricing or Contract Time modifications.
- C. Change Order provides accounting of any Contract Sum and Contract Time adjustment.

1.14 UNIT PRICE CHANGE ORDER

- A. For pre-determined unit prices and quantities, Change Order will be executed on a fixed price basis.
- B. For unit costs or quantities of units of work which are not predetermined, execute Work under a Construction Change Directive. Changes in Contract Sum or Contract Time will be computed as specified for a time and material Change Order.

1.15 TIME AND MATERIAL NOT-TO-EXCEED CHANGE REQUEST

- A. Submit itemized account and supporting data daily during the course of the Work.
- B. Owner and Architect will determine the change allowable in Contract Sum and Contract Time as provided in the General Conditions of the Contract.
- C. Maintain and provide detailed records of work done on a time and materials basis and submit verified records at the end of each day to the Owner for review and acceptance.

1.16 EXECUTION OF CHANGE ORDERS

- A. Change Orders will be issued via e-Builder for approval of parties as provided in General Conditions.
 - 1. Form for Change Orders: District's "Change Order" form.
- B. Fully executed forms for CCDs or Change Requests authorize Contractor to proceed with Change.
- C. Promptly sign and date Change Order or provide detailed written and signed statement detailing reasons if refusing to sign. If the Contractor does not sign and return the Change Order, all aspects will be considered disputed, and Contractor shall not be paid on any Work on it.

1.17 DISTRIBUTION

- A. Owner will distribute one electronic copy to Architect and Contractor for review.
- B. Change Orders: Upon authorization, all parties will sign originals with original or original scanned signatures.
 - 1. Project procedures for distribution will be discussed and agreed upon at the preconstruction meeting.
 - 2. All parties will receive fully executed digital copies of the Change Order for record.
- C. Construction Change Directives: Upon authorization, Owner will initiate e-Builder CCD process which will include acceptance steps by Architect and Contractor.
 - 1. Directive describes Work Change additions or deletions, with attachments of revised Contract Documents.

1.18 CREDIT AMOUNT TO CONTRACT SUM - INSURANCE

- A. If a Change Order or Construction Change Directive results in a reduction of the Contract Sum, the Owner shall be entitled to a credit that includes the amount of the value of bond premium and amounts charged for additives for insurance premium and any other allowable markups.

1.19 CORRELATION OF CONTRACTOR SUBMITTALS

- A. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item. Adjust Contract Sum as shown on Change Order.
- B. Promptly revise Progress Schedule to reflect any changes in Contract Time, revise subschedules to adjust times for other items of work affected by the change, and resubmit.
- C. Promptly enter changes in Project Record Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Contractor's coordination.
- B. Electronic document exchange service.
- C. Prebid conference.
- D. Preconstruction meeting.
- E. Progress meetings.
- F. Preinstallation conferences.
- G. Project closeout conference.
- H. Requests for information (RFI).
- I. Submittals for review, information, and project closeout.
- J. Number of copies of submittals.
- K. Deferred submittals.
- L. Submittal procedures.
- M. Product submittals - detailed requirements.
- N. Timing of submittals.
- O. Construction progress schedule.
- P. Schedule of values.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Delegate design requirements.
- B. Section 01 31 23 - Project Management Database (PMD).
- C. Section 01 32 00 - Construction Progress Documentation: Form, content and administration of schedules.
- D. Section 01 35 14 - LEED Credit Summary.
- E. Section 01 40 00 - Quality Requirements: Testing Laboratory Reports and Manufacturer's Field Services.
- F. Section 01 60 00 - Product Requirements: Contractor's list of Products.
- G. Section 01 70 00 - Execution: Additional coordination requirements.
- H. Section 01 78 00 - Closeout Submittals: Project record documents.

1.03 CONTRACTOR'S COORDINATION

- A. Coordinate Work of all personnel, requirements and Work specified throughout the Contract Documents, including Work performed by subcontractors and suppliers.
- B. Coordinate scheduling, submittals, and the work of the various Sections of the Specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- C. Contractor's work and responsibilities include, but are not limited to, the following:
 - 1. Provide all labor, materials, equipment, delivery, tools, machines, facilities, and services necessary for the proper execution of the Work.
 - 2. Coordinate scheduling, submittals and Work of the various Sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later. This shall include the coordination of OFCI and OFOI components.

3. Ensure that notification to and inspections by permitting agencies are completed in a timely fashion.
 4. Coordinate utility outages with a minimum of 72 hours advance notice to Owner.
 5. Store, protect, and secure materials, on and off site.
 6. Supervise and coordinate after hours work.
- D. The separation of portions of the Work into particular divisions of the specifications or sections of the drawings may not in every case conform to the categories of work typically subcontracted to particular crafts or trades. Inform bidders, subcontractors, crafts and trades that work assigned to them may be contained in sections other than customary. In every case, provide and coordinate at no additional cost to Owner, all work required in the Contract Documents.
- E. Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, all such equipment.
- F. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for piping, ductwork, and conduit as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
1. The Architect may make minor adjustments in fixture, outlet, grille, louver, access hatch or ventilator locations prior to rough-in work with no additional cost.
- G. In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish construction and components.
- H. Coordinate completion and cleanup of Work of separate Sections in preparation for Substantial Completion and for portions of Work designated for Owner occupancy.
- I. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner activities.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT EXCHANGE SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
1. Besides submittals for review, information, and closeout, this procedure applies to submittal schedule, requests for information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change requests, change orders, construction change directives), applications for payment, field reports and meeting minutes, substitution requests and any other document any participant wishes to make part of the project record or as required by the Owner.
 2. Contractor and Architect are required to use this service.
 3. It is Contractor's responsibility to submit documents in PDF format.
 - a. Limit PDF size to 10MB, unless otherwise authorized by Architect.
 - b. Name PDF's for product submittals is indicated under "Product Submittals - Detailed Requirements" Article.
 4. Subcontractors, suppliers, Architect, and Architect's consultants will be permitted to use certain modules available at no extra charge.
 5. Users of the service need an email address, Internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.

6. Paper document transmittals will not be reviewed; emailed PDF documents will not be reviewed.
 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Submittal Service: The selected service is:
1. E Builder. Refer to Section 01 31 23 - Project Management Database (PMD) for additional information.
- C. Training: One, one-hour training session will be arranged for all participants, with representatives of Architect, Architect's Consultants and Contractor participating; further training is the responsibility of the user of the service.
- D. Project Closeout: Coordinate with Architect and Owner to verify that archive documents have been saved and remain accessible to Architect and Owner prior to terminating the service for the project.

3.02 PREBID CONFERENCE

- A. A mandatory Pre-Bid Conference has been scheduled for the date, time and location indicated in the Instructions to Bidders.
- B. No bid will be accepted from General Contractor Bidders who did not attend the Pre-Bid Conference. Attendance by subcontractors is not required, however, subcontractors are encouraged to attend.

3.03 PRECONSTRUCTION MEETING

- A. The Owner will schedule a preconstruction conference before the start of construction, at a time convenient to the Owner, Contractor and the Architect. The conference will be held at the Project Site or another convenient location. The meeting shall be conducted to review general issues of responsibilities, communications, and contract administration procedures.
- B. Attendance Required:
1. Owner.
 2. Architect.
 3. Contractor.
 4. Contractor's Superintendent.
 5. Major Subcontractors.
 6. Major Suppliers when requested; others as appropriate.
- C. Agenda:
1. Status of the Contract, bonds, insurance or other contract requirements.
 2. Status/timing of Notice to Proceed.
 3. Distribution of Contract Documents.
 4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
 5. Designation of personnel representing the parties to Contract and Architect.
 6. Contract administration responsibilities, communications and procedures.
 7. Project management communications and database requirements (E-Builder).
 8. Tentative Contractor's construction schedule.
 9. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 10. Scheduling.
 11. Related work by Owner and coordination with Contractor.
 12. Use of premises and ongoing facility operations.
 13. Review of existing conditions.
 14. Hazardous materials.
 15. LEED requirements.
 16. Owner's requirements.
 17. Working hours, site access and parking.

18. Contractor's site mobilization and storage areas.
 19. Material and equipment deliveries.
 20. Maintaining good neighborhood relations and achieving noise, store water, erosion and dust control.
 21. Construction facilities and controls.
 22. Temporary storage.
 23. Security and housekeeping procedures.
 24. Special inspection, testing and quality control, including procedures for testing.
 25. Procedures for maintaining record documents.
 26. Requirements for start-up of equipment and Commissioning.
 27. Inspection and acceptance of equipment put into service during the construction period.
 28. Status of permits.
 29. Progress meeting schedule date and time.
 30. Review of Contract Documents and outstanding questions related thereto.
- D. Owner will record minutes and distribute copies within two days after meeting to participants, with copies to all participants, and those affected by decisions made.

3.04 PROGRESS MEETINGS

- A. Progress meetings will be conducted at the Project Site on a weekly basis, or at intervals otherwise agreed to. The schedule of the meetings shall be established by mutual consent of the Owner, Architect and Contractor. No changes to said schedule shall be made without mutual consent of the same parties. Coordinate preparation of the payment request with dates of meetings.
1. Notify subcontractors and other representatives of scheduled meetings where their attendance is requested.
- B. Owner will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendees: In addition to representatives of the Contractor, Owner and the Architect, other individuals concerned with current progress or coordination may be represented at these meetings. Participation by Subcontractors shall be limited to attendance only when required by the Architect or when a prearranged topic relating to the specific trade or supplier requires their attendance at the meeting.
1. Persons designated by the Contractor to attend and participate shall have all required authority to commit the Contractor to solutions as agreed upon in the meeting.
- D. Agenda:
1. Review minutes of previous meetings.
 2. Review of Work progress.
 3. Field observations, problems, and decisions.
 4. Identification of problems that impede, or will impede, planned progress.
 5. Review of submittals schedule and status of submittals.
 6. Status of RFI's, ASI's, Proposal Requests, CCD's and Change Orders.
 7. Review of off-site fabrication and delivery schedules.
 8. Site access, utilization and parking.
 9. Problems from or affecting occupants or neighbors.
 10. Permitting and agency issues.
 11. Quality/inspection issues.
 12. Maintenance of progress schedule.
 - a. Review progress since the last meeting;
 - b. Distribute Contractor's three-week look ahead schedule.
 - c. Evaluate current activity is in relation to the Contractor's Schedule.
 - d. Identify in advance potential delays involving: submittals, material / equipment procurement; approvals; Owner-furnished materials; or separate contracts, if any.

- e. Determine how construction behind schedule will be expedited; securing commitments from parties involved to do so.
 - f. Determine whether a recovery schedule is required for the Contractor's Construction Schedule to insure completion within the contract time.
- 13. Coordination of projected progress.
 - 14. Maintenance of quality and work standards.
 - 15. Effect of proposed changes on progress schedule and coordination.
 - 16. Pay Application review at monthly interval.
 - 17. Review of Project Record Documents, both field sets and electronic forms.
 - 18. Contractor's update of status of OCIP enrollment by project participants.
 - 19. BIM updates.
 - a. Model coordination.
 - b. Clash detection.
 - 20. LEED documentation and conformance.
 - 21. Other business relating to Work.
- E. Owner will record minutes and distribute copies within three days after meeting to participants, with one copy to each participant and those affected by decisions made.
- 1. Minutes shall number topics in a manner that reflects when each topic was first raised.
 - 2. Each topic shall reflect who is responsible for acting on the topic and date by which resolution is required.
 - 3. No topic shall be dropped from the minutes until the method of resolution is recorded.

3.05 PREINSTALLATION CONFERENCES

- A. When required in individual Specification Sections, convene a preinstallation conference at work site prior to commencing work of the Section.
 - 1. Additional conferences may be conducted as required for performance of the Work.
- B. Attendees: The Installer and representatives of manufacturers and fabricators, sub-contractors, Contractor, Owner's representative and Owner's special inspector involved in or affected by the installation, and its coordination or integration with other materials and installations, shall attend the meeting. Advise the Architect of scheduled meeting dates.
- C. Notify Architect and Owner minimum four days in advance of meeting date.
- D. Agenda: Review the progress of related construction activities, including drawing and specification requirements for the following:
 - 1. Shop Drawings, Product Data, and quality-control samples and other required submittals.
 - 2. Time schedules,
 - 3. Weather limitations.
 - 4. Manufacturer's recommendations.
 - 5. Warranty requirements.
 - 6. Acceptability of substrates.
 - 7. Quality, inspection, and testing requirements.
 - 8. Assessment of risk.
- E. Review conditions of installation, preparation and installation procedures, and coordination with related work.
- F. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
- G. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
- H. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

3.06 PROJECT CLOSEOUT CONFERENCE

- A. Request a meeting to discuss the requirements for project closeout.

- B. Attendees: In addition to representatives of the Contractor, Owner and the Architect, other individuals concerned with project closeout may be represented at these meetings.
- C. Agenda:
1. Preparation of record documents.
 2. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 3. Submittal of written warranties.
 4. Requirements for preparing sustainable design documentation.
 5. Requirements for preparing operations and maintenance data.
 6. Requirements for demonstration and training.
 7. Preparation of Contractor's punch list.
 8. Completion time for correcting deficiencies.
 9. Inspections by authorities having jurisdiction.
 10. Certificate of occupancy and transfer of insurance responsibilities.
 11. Partial release of retainage.
 12. Preparation for final field observation.
 13. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 14. Submittal procedures.
 - a. Project Record Documents.
 - b. Operating and maintenance documents.
 - c. Final commissioning documentation.
 - d. Warranties and bonds.
 - e. Affidavits.
 - f. Turnover of extra materials and spare parts.
 15. Owner's partial occupancy requirements.
 16. Installation of Owner's furniture, fixtures, and equipment.
 17. Responsibility for removing temporary facilities and controls.
 18. Final cleaning.
 19. Contractor's demobilization of site.
 20. Maintenance.
- D. Owner will record meeting minutes.

3.07 REQUESTS FOR INFORMATION (RFIS)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, prepare and submit an RFI in the form specified.
1. RFIs shall originate with Contractor. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 2. Limit topics on each RFI to a single topic to expedite response.
 3. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
 4. Endeavor to keep the number of RFI's to a minimum. In the event that the process becomes unwieldy, in the opinion of the Architect, because of the number and frequency of RFI's submitted, the Architect may require the Contractor to abandon the process and submit all requests as either submittals, substitutions or requests for change.
 5. Endeavor to answer all RFI's from subcontractors. Only RFI's the Contractor cannot answer shall be submitted through, reviewed by, numbered sequentially by and signed by the Contractor prior to submittal to the Architect.
 6. If Contractor disagrees with Architect's response to Contractor's RFI, Contractor shall notify Architect within seven days of receipt of response. Lack of such notification shall be understood to mean that Contractor agrees with response.
 7. Contractor and Architect shall utilize the Owner's web-based management system to submit and receive RFI's and their responses. Refer to Section 01 31 23 - Project Management Database (PMD).

- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Date.
 3. Name of Contractor.
 4. RFI number, numbered sequentially.
 5. RFI subject.
 6. Specification Section number and title and related paragraphs, as appropriate.
 7. Drawing number and detail references, as appropriate.
 8. Field dimensions and conditions, as appropriate.
 9. Reason for need for interpretation.
 10. List of subcontractors involved.
 11. Contractor's suggested resolution. If the proposed solution impacts the Contract Time or the Contract Sum, state the impact in the RFI.
 12. The following statement:
 - a. "This reply is not an authorization to proceed with work involving additional cost, time or both. If any reply requires a change to the Contract Documents, a Change Order or Construction Change Directive must be executed in accordance with the Contract Documents prior to implementation of the reply. Proceeding with the Work in accordance with this RFI response indicates Contractor's acknowledgement that there will be no change in the Contract Sum or Contract Time."
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: Owner's software-generated form with the content specified and as acceptable to the Architect.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of substitutions.
 - b. Requests for adjustments in the Contract Time or the Contract Sum.
 - c. Requests for interpretation of Architect's actions on submittals.
 - d. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Request according to Section 01 26 00 - Contract Modification Procedures.
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 20 days of receipt of the RFI response.
 - b. A response to an RFI is not direction or approval of a change to either Contract Time or Contract Sum.
 - c. Proceeding with the Work in accordance with an RFI response, without such written notification and an approved Change Order or Construction Change Directive, indicates Contractor's acknowledgement that there is no change to the Contract Time or the Contract Sum.
- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number using Owner's web-based management system. Submit the RFI Log at each Project Meeting. Include the following:

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

3.08 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 1. Product data.
 2. Shop drawings.
 3. Samples for selection.
 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed only for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

3.09 DEFERRED SUBMITTALS

- A. For delegated design elements defined in Section 01 10 00 - Summary, submit deferred submittals in accordance with the specified requirements and in accordance with Section 107.3.4.2 of the Oregon Structural Specialty Code. Follow City of Portland requirements current at the time of submission.
- B. Submission will include the following, as a minimum, in quantities as required by the City:
 1. Drawings showing all members, sizes, fastener information, where applicable, dimensions, connections, materials used and how attached to the main structure.
 2. Calculations, including criteria, design assumptions, substantiating computations and such additional data sufficient to show compliance with Code.
 3. Product information.
 4. Drawings and calculations must be stamped and signed by an Engineer registered in Oregon and must have Architect/Engineer of record's submittal review stamp.
- C. Architect or Engineer, as applicable, will review delegated design submittals, and, if the submittal is acceptable and receives a "No Exceptions Taken" or "Make Corrections Noted" action, will forward to the Contractor for submission to the building official with annotation indicating that the deferred submittal documents have been reviewed and that they have been found to be in general conformance with the design of the building.
- D. The Architect's and Engineer's approval is contingent upon approval of submittal by governing authorities.
- E. Contractor shall be responsible for submission to the governing agency and for coordinating with the governing agency for timely review and approval of the submittals. Architect and Owner will not be responsible for delays due to failure of the Contractor to submit with adequate time allowance for agency review of the submittals.
- F. The deferred submittal items shall not be installed until their design and submittal documents have been approved by the building official.
- G. Contractor is responsible for obtaining written approval from governing authority for all Deferred Submittals.
- H. Contractor is responsible for obtaining and costs associated with applicable permits for delegated design elements as required by governing authority.

3.10 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:

1. Design data.
2. LEED submittals and reports.
3. Certificates.
4. Test reports.
5. Inspection reports.
6. Manufacturer's instructions.
7. Manufacturer's field reports.
8. Other types indicated.

B. Submit for Architect's knowledge as contract administrator for Owner. No action will be taken.

3.11 SUBMITTALS FOR PROJECT CLOSEOUT

A. When the following are specified in individual sections, submit them at project closeout:

1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
4. Bonds.
5. Other types as indicated.

B. Submit for Owner's benefit during and after project completion.

3.12 NUMBER OF COPIES OF SUBMITTALS

A. Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.

1. After review, produce duplicates.
2. Retained samples will not be returned to Contractor unless specifically so stated.

3.13 SUBMITTAL PROCEDURES

A. Transmit each submittal with a copy of approved submittal form.

B. Submit Schedule of all shop drawings, product data, and samples as specified in each individual Section of the Project Manual. Include submittal and installation dates of each product and assembly. Coordinate with construction schedule and allow ample time, but in no case fewer than 10 days, for Architect's review. Allow time for possible disapproval, correction, and resubmittal.

C. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

1. Provide a separate PDF for each submittal element (Product Data, Shop Drawings, etc.) for each specification Section.
 - a. Submit all elements for any Section as a single submittal at the same time.
 - b. Do not combine submittals for multiple specification Sections, unless previously approved by the Architect.
2. Number submittals as indicated in Product Submittals - Detailed Requirements Article.
3. No secure PDFs allowed.
4. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

D. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

E. 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 prior to submission.

1. Architect will not accept or process submittals which do not have Contractor's signed stamp that reflects Contractor's review and approval.

2. Submission of submittal by Contractor represents that Contractor has fully reviewed and certified acceptance.
- F. Submit submittals to Architect as indicated in Electronic Document Exchange Service Article above.
- G. Schedule submittals to expedite the Project, and coordinate submission of related items.
- H. Do not fabricate products or begin work which requires submittals prior to return of submittal with Architect acceptance.
- I. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
 1. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved by Architect's review of submittals, unless Contractor notates specific deviations and the deviations are specifically approved by the Architect.
- J. Provide space for Contractor and Architect review stamps.
- K. When revised for resubmission, identify all changes made since previous submission.
- L. Submittals not requested will be returned without review.
- M. Contractor is responsible for timely and efficient submittals and the correctness of the documentation submitted. Costs associated with multiple reviews of submittal information beyond one re-submittal (if any) shall be the responsibility of the Contractor.
- N. The Contractor is responsible for timely submittals of any required deferred submittals to the governing agencies.

3.14 PRODUCT SUBMITTALS - DETAILED REQUIREMENTS

- A. Present in a clear and thorough manner. Title each drawing with Project Name.
- B. Identify field-verified dimensions; show relation to adjacent or critical features of Work or products.
- C. Number submittals by submittal section number, followed by a two letter designation for the type of submittal and a number which sequentially numbers submittals in order submitted to Architect. For example, the initial submittal of Joint Sealers 07 90 05 Product Data would be designated 079005-PD-1. If the submittal must be resubmitted it shall be identified as 079005-PD-1R1 and subsequent resubmittal shall be sequentially numbered in order as resubmitted.
- D. Shop Drawings (SD):
 1. Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproduction of the Contract Documents or standard printed data.
 2. Fully illustrate requirements in the Contract Documents including, but not limited to:
 - a. Identification of products.
 - b. Compliance with specified standards.
 - c. Notation of coordination requirements.
 - d. Notation of dimensions established by field measurement.
 - e. Relationship and attachment to adjoining materials or assemblies, relevant field conditions and all necessary dimensions.
- E. Product Data (PD):
 1. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to Specification Section and Article number.
 2. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the Work. Delete information not applicable.
 3. Product data that has not been marked to indicate the applicable information will be returned without review.
 4. Contractor shall assemble Product Data required for maintenance manuals and submit to Architect in accordance with Section 01 78 00 - Closeout Submittals.
- F. Samples (SA):

1. Samples for Initial Selection: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected. Architect will retain selected sample for confirmation of subsequent submittals.
 2. Submit samples to illustrate functional characteristics of products, including parts and attachments.
 3. Approved samples which may be used in the Work are indicated in the individual Specification Sections.
 4. Label each sample with identification required for transmittal letter.
 5. Verification Samples: Submit the number of samples specified in individual Specification Sections. One of which will be retained by the Architect.
 - a. Submit three copies if no number is indicated.
 - b. Submit additional samples when copies will be required for distribution to other subcontractors or fabricators for matching or preparation of finish samples.
 6. Provide field samples of finishes at project site, at location acceptable to Architect, as required by individual Specifications Section. Install each sample complete and finished. Acceptable finishes in place may be retained in completed work if approved by Architect.
- G. Manufacturer's Instructions (MI):
1. Provide at Minimum: Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, balancing, and finishing in accordance with Section 01 40 00 - Quality Requirements.
- H. Manufacturer's Certificates (MC):
1. When specified in individual Specification Sections, submit manufacturers' certificate to Architect/Engineer for review, in quantities specified herein.
 2. Indicate material or product in conformance with or exceeding specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 3. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect.

3.15 TIMING OF SUBMITTALS

- A. General:
1. The listing of submittals hereinafter is set forth as a checklist for Contractor's convenience and is general in nature.
 2. Architect reserves the right to add to this list in case of omission of any submittals specified in other Sections but not listed hereinafter.
- B. Submittals - Required per approved submittal schedule:
1. Contractor's Qualification Statement.
 2. Letter from Insurance Company - insurance required effective upon Contract.
 3. Letter from Surety - bonds required effective upon Contract.
 4. Breakdown of bid (if requested).
 5. Names of proposed suppliers for each of the principal portions of the Work.
 6. Contractor's Construction Management Personnel: Project Manager - minimum 3 years experience; Field Superintendent - minimum 5 years experience.
 7. Responsibility of Subcontractors.
 8. A designation of the Work to be performed by the Contractor by his own forces.
- C. Submittals - Prior to Notice to Proceed:
1. Executed Agreement.
 2. Certified copies of Contractor's Liability Insurance Policies (AIA Document G705 or approved equivalent).
 3. Final list of subcontractors and major material suppliers for principal portions of the Work.
 4. Evidence of bondability (Performance Bond and Payment Bond).
 5. Certificates of Insurance (on AIA Document G705 or approved equivalent)
 6. Actual costs (%) of the Contractor's liability insurance.
 7. Endorsements for additional insured.

8. Statements of State Worker's Compensation coverage.
 9. Copy of Builder's Risk Policy.
 10. Project Organizational Chard.
 11. Key staff resumes with telephone and contact information.
 12. Summary of Warranties included in Bid, including duration and start time of each. Itemize any deviations from Bid Document requirements.
 13. Other documents required by Contract Documents.
- D. Submittals - Within Seven Days Following Contract Execution and Prior to Commencing Work:
1. Deliver Bonds to Owner with copy to Architect.
 2. Performance and Labor & Material Payment Bonds per Oregon Law with certified copy of Power of Attorney from Attorney-in-Fact executing bonds.
 3. Certified Schedule of Prevailing Wage Rates (attach to executed contract).
- E. Submittals - Within Thirty Days Following Notice to Proceed and Prior to First Payment Application:
1. Schedule of values - submit at least 10 days in advance of application.
 2. Schedule of submittals.
 3. Copies of acquired and unacquired building permit licenses etc. to complete the Work of the Contract. Submit copies of any remaining permits as they are acquired.
 4. Construction schedule.
- F. Submittals - Prior to Each Month's Progress Payment:
1. Submit 10 days in advance of date established for progress payment.
 2. Application and Certificate for Payment (PPS Payment Application form).
 3. Notarized affidavit of payments to all subcontractors and major material suppliers (see application for payment).
 4. Updated Construction Schedule.
 5. Public Works Contractor Wage Certification per Oregon Law.
- G. Submittals - Prior to request for Substantial Completion:
1. Notification to Architect that Work of the Project is substantially complete.
 2. Itemized listing of items of work to be completed or corrected.
 3. Submit Certificate of Occupancy or Occupancy Permit issued by the Local Building Department for the entire Project.
 4. Draft Operations and Maintenance Manuals and draft warranties.
- H. Submittals - Prior to request for Final Completion:
1. Certified copy of punchlist items completed.
 2. Submit final Application for Payment.
 3. Summary of commissioning indicating all required items are completed.
 4. Demonstration and Training training reports.
 5. Final complete and correct Operations and Maintenance Manuals.
 6. Record Drawings of Contract Documents with all changes indicated.
 7. Final dated and signed Warranties.
 8. Completed LEED documentation.

3.16 CONSTRUCTION PROGRESS SCHEDULE

- A. Submit initial progress schedule as required in Section 01 32 00 - Construction Progress Documentation.
- B. Revise and resubmit as required.
- C. Review revised schedules with each Application for Payment, identifying changes since previous version.
- D. See Section 01 32 00 for specific requirements.

3.17 SCHEDULE OF VALUES

- A. Submit typed schedule on PPS Payment Application form. Contractor's standard form or media-driven printout will be considered on request.
- B. Comply with requirements in Section 01 20 00 - Price and Payment Procedures.

END OF SECTION

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preliminary baseline schedule.
- B. Final construction baseline schedule.
- C. Progress reports.
- D. Material location reports.
- E. Field condition reports.
- F. Special reports.

1.02 RELATED SECTIONS

- A. Section 01 31 23 - Project Management Database (PMD).

1.03 REFERENCES

- A. AGC (CPSM) - Construction Planning and Scheduling Manual; Associated General Contractors of America.

1.04 SUBMITTALS

- A. Preliminary Baseline Schedule: Within 14 days after date of Owner's Notice of Intent to Award the Contract, submit preliminary baseline schedule defining planned operations for the entire scope of Work.
 - 1. Submit minimum two hard copies to Owner for review.
 - 2. Submit XER file to Owner for review.
 - 3. If preliminary baseline schedule requires revision after review, submit revised schedule within 10 days.
 - 4. The data date is to be set to Notice of Award.
- B. Final Construction Baseline Schedule: Within 30 days after date established in Notice to Proceed, submit draft of proposed complete schedule for review.
 - 1. Include written certification that mechanical and electrical Subcontractors have reviewed and accepted proposed schedule.
 - 2. Not less than 25 percent of the initial Application for Payment may be withheld until a complete Construction Progress Schedule has been submitted in a form acceptable to Architect and Owner.
 - 3. Neither Owner nor Architect shall be responsible for review of the entire substance of the Progress Schedule.
 - 4. Final Baseline CPM Schedule with Resources (man-hours): Within 60 calendar days of receiving Notice of Award, the key subcontractor's man-hours are to be added to the baseline schedule and submitted as a Final Baseline. This Final Baseline will be used for future schedule comparisons and GMP. Data Date is set to Notice to Proceed.
 - 5. Submit updated schedule with each Application for Payment.
 - 6. At each progress meeting, submit the following:
 - a. Weekly Progress Schedule: Once the Final Baseline Schedule has been approved, the Data Date will be advanced. The Data Date will be set to the Monday of each week at the start time (08:00 if work starts at 8:00). Data Date is to be advanced weekly throughout the duration of the project. Prepare a three-week look-ahead schedule listing current and upcoming activities by trade, including anticipated start and complete dates as applicable.
 - 7. Submit the following at the end of each month:
 - a. Monthly Progress Schedule: The last weekly update in a month will be submitted as the Monthly Progress Schedule. Coordinate with the Owner as to which weekly

progress schedule to use if the start or end of the month falls on an unusual day of the week.

- b. Monthly Progress Narrative: Submit within 5 working days of the Monthly Progress Schedule Submittal. Include the monthly scheduling reports with the narrative.
- C. Progress Reports: Submit at weekly intervals.
- D. Material Location Reports: Submit at monthly intervals.
- E. Field Condition Reports: Submit at time of discovery of differing conditions.
- F. Special Reports: Submit at time of unusual event.

1.05 QUALITY ASSURANCE

- A. Scheduling Kick-Off Meeting: Within 7 days of receipt of Owner's Notice of Intent to Award, coordinate with Owner to schedule a Scheduling Kick-Off Meeting. The purpose of the meeting is to:
 - 1. Allow the Contractor to receive and review the Owner's existing detailed master schedule.
 - 2. Discuss implementation of the Contractor's schedule.
 - 3. Review project scheduling requirements.
 - 4. Memorialize any acceptable deviations from requirements.
- B. Scheduler: Designate a person or firm for all aspects of managing the CPM schedule and database. This includes preparation, revisions, updating, and all required submittals. The Project Scheduler shall be approved by the Owner based on a resume indicating as a minimum 4 years of experience with CPM schedules on construction projects of similar size and complexity. The Owner may reject the Project Scheduler or firm if they are unable to produce an approved or organized schedule, even if they meet the above qualifications.
 - 1. At any time, the Owner may request the presence of the scheduler at any meetings to review the schedule's logic.

1.06 SCHEDULE FORMAT AND GENERAL REQUIREMENTS

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- B. Diagram Sheet Size: Maximum 30 x 42 inches or width required.
- C. Scale and Spacing: To allow for notations and revisions.
- D. All schedule submittals will include the required reports and the data file in the form of an XER transmitted via email and/or FTP site. The XER will contain the entire schedule including assigned resources. Each XER submittal should have a unique file name indicating baseline, weekly or monthly, the Contractor's name and the Data Date. Each report should have the Data Date, Contractor's name and report name.
- E. The schedule may be used as the basis for determining contract earnings during each update period and therefore the amount of each progress payment. Lack of an approved schedule, qualified scheduling personnel, or failure of the Contractor to provide all required information will result in the disapproval of the schedule and may be grounds for withholding progress payments and/or for a determination by the Owner that the Contractor is not prosecuting the Work with sufficient diligence to ensure completion within the time specified in the Contract. Upon making this determination, the Owner may terminate the Contractor's right to proceed with the Work, or any separate part of it, in accordance with the default terms of the Contract. If, in the opinion of the Owner, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress including those that may be required by the Owner, without additional cost to the Owner. In this circumstance, the Owner may require the Contractor to increase the number of shifts, overtime operation, days of work and/or the amount of construction, and to submit for approval any supplementary schedule or schedules as the Owner deems necessary to demonstrate how the approved rate of progress will be regained.

PART 2 PRODUCTS

2.01 PRELIMINARY BASELINE SCHEDULE

- A. Prepare preliminary baseline schedule in the form of a preliminary network diagram.
 - 1. Utilize Primavera P6 or approved equivalent capable of producing XER file.
- B. Content:
 - 1. Illustrate the entire scope of Work at a high level with at least one activity per subcontractor or responsibility per general area.
 - 2. All Owners' tasks that Contractor will be relying on for timely completion of the project.
 - 3. All submittals required to allow construction to begin. Allow 20 working days for review of submittals by the Owner. Include both a Contractor's submittal and an Owner's review as two separate activities.
 - 4. All major or long lead procurement items being procured by either the Owner or the Contractor. Consult with the Owner on any procurement items or durations prior to the Preliminary Baseline Schedule submittal.
 - 5. All required activity coding.
 - 6. Punch List Activities: Include separate punch list steps for the interior of the building versus the exterior of the building. Include separate activities for Contractor punch list, Contractor corrections, Owner/Architect punch list, and Contractor corrections. Allow a minimum of 5 days for the initial Owner/Architect punch list.
 - 7. Commissioning Activities: Include 1 week for each system and a minimum of 2 weeks for total commissioning.
 - 8. Include Owner Controlled Float Activities as specified.
 - 9. Utilize correct logic and relationship ties.
 - 10. Utilize Contractor's best estimate on activity durations.
 - 11. All Milestones from the contractual milestone list and interim phasing and goal type milestones.
 - 12. Only contractual constraints are allowed. All schedule constraints must be pre-approved by the Owner.
 - 13. Only two open ends: The first activity - Notice to Proceed - has no predecessor and the last activity - Project Complete - has no successor. All other activities have both a predecessor and successor.
 - 14. All required reports and a data file in XER format.
 - 15. Coordinate with existing Owner Schedule for integration as requested by Owner.
 - 16. Incorporate Owner comments.
 - 17. Provide separate schedule of submittal dates for shop drawings, product data and samples, Owner-furnished products, products identified under Allowances and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.
 - 18. Include a line item for Project Closeout.
 - 19. Include not less than 15 days for startup and testing.
 - 20. Indicate delivery dates for Owner-furnished products and products identified under Allowances.
 - 21. Coordinate content with Schedule of Values specified in Section 01 20 00 - Price and Payment Procedures.
 - 22. Include not more than 30 days for punch list and final completion, unless otherwise indicated.
 - 23. Provide legend for symbols and abbreviations used.
 - 24. Closeout and Commissioning: In the Contractor's Construction Schedule, provide key activities required in Sections 01 77 00 - Closeout Procedures, 01 78 00 - Closeout Submittals and 01 91 13 - General Commissioning. These activities will be cost-loaded to a cumulative total of not less than 2 percent of the contract value.

2.02 FINAL BASELINE SCHEDULE

- A. The approved Final Baseline CPM Schedule is to be used as the master schedule. It will be used to measure the progress of the Work and aid in evaluating time extensions. After approval, the Final Baseline will be archived and a copy will be used to begin the weekly update process. The Final Baseline CPM Schedule is to include:
1. All requirements of the Preliminary Baseline Schedule.
 2. All required submittals and review periods.
 3. Illustrate the complete scope of work with general area, sub-area, and subcontractor level tasks (not day by day or overly specific sequences unless required due to craft interaction, hold points, or other inspections).
 4. All activities should have only one subcontractor per activity. All subcontractors should have at least one activity. If there are planned gaps in work, use multiple activities to represent their work.
 5. All construction activities should be 20 days or less in duration unless approved by the Owner.
 6. All construction activities are to be resource man-hour loaded, based on general Contractor and/or subcontractor bid man-hours.
 - a. Verify the man-hours with the key subcontractors immediately and estimate the minor subcontractor's man-hours.
 - b. Once the minor subcontractors have signed their contracts, they should supply their estimated man-hours.
 - c. Advise the Owner of upcoming minor subcontractor changes to the man-hour estimate, update those man-hours on the Monthly Progress Schedule, and document the changes in the Monthly Narrative.
 7. Do not change the budgeted man-hours without Owner approval.
 8. If requested by the Owner, cost load all construction activities.

2.03 WEEKLY PROGRESS SCHEDULES

- A. The Weekly Progress Schedule is to be updated weekly and will be considered the contemporaneous master schedule. It may be used as an aid in evaluating time extensions. The Data Date will be set to the Monday of each week at the normal start time of the primary construction calendar (08:00 if work starts at 8:00). Data Date is to be advanced weekly throughout the duration of the project. Activities behind (to the left of) the Data Date will have been completed. Activities in front (to the right) of the Data Date have not started. Activities crossing the Data Date are in progress. The Weekly Progress Schedule should:
1. Accurately update the actual start and finish date of all activities that occurred during the previous week.
 - a. The Start Date is the date upon which the Work is commenced in earnest, not preliminary or preparatory work, unless identified as such in the schedule.
 - b. Finish Date will be the date at which the Work is Substantially Complete enough for follow-on work to begin. It does not signify that any or all punch list items are complete or that the Work can be billed for 100 percent. Earned value will be evaluated separately from substantial progress.
 2. Accurately update the Remaining Duration for all work that is statused as In Progress at the time of the update. Remaining Duration shall be updated independently of activity Percent Complete.
 3. Accurately update the achieved Percent Complete of each task activity as of the end of the preceding week. Use of Earned Value tracking methods is recommended but not required.
 4. Document all delays that occurred during the week. Add an activity for that delay with actual start and finish dates and discuss these activities at the weekly schedule meeting.
 5. Activities two weeks or less in front of Data Date can be changed to show slight estimated duration changes, sequence/logic changes or changes in calendars (work on weekends) so as to better illustrate how the work will be executed.
 6. If multiple calendars are used, include a column on all reports showing the calendars.

7. Changes beyond two weeks out can only be adjusted for the Monthly Progress Schedule and must be documented in the Monthly Narrative.
 8. Submit PDF reports listed in the report section and data file in the form of an XER on a weekly basis by close of business on each Monday.
 9. Incorporate Owner comments.
 10. Dates from previous weeks cannot be changed once the weekly progress schedule has been submitted except with permission from the Owner.
 11. All schedule mechanics must be followed on each update.
- B. Weekly Schedule Review: The Contactor's Project Manager, Authorized Scheduler, Key Subcontractors and Owner shall attend to review the following:
1. Status of Just Complete Tasks: From the weekly schedule update, review last week's tasks, including Actual Start dates (AS), Actual Finish Dates (AF), Remaining Durations (RD) and Percent Complete.
 2. At a minimum, address the following items on an activity by activity basis during each progress meeting.
 - a. Discuss all delays that occurred during the week and recovery plans.
 - b. Upcoming Activities: Review logic, duration, crew size, material or equipment needs.
 - c. Critical Activities: Understand and review the activities that must finish on time to avoid a delay to the project completion date. Discuss opportunities to complete these tasks early.
 3. Prepare and distribute the following reports to each participant before the start of the meeting. If requested, be able to place these reports on a screen via an overhead projector for discussion. Reports should include as a minimum:
 - a. Activity ID, Activity Name, Original Duration, Remaining Duration and Total Float.
 - b. Last Week and Three Week Look Ahead indicating crew size or man-hours, subcontractor responsibility. Include separate sections for each Phase (submittals, procurement, construction and commissioning). Include finish date, variance to last week and a variance bar.
 - c. Two month look ahead of critical and near critical activities.
 - d. Critical and near Critical Paths.
 - e. Any report or modification to any of the above reports requested by the Owner.
- C. Schedule Constraints: Minimize the use of activity schedule constraints as much as possible. Mandatory and Start On or Finish On type constraints are not allowed.
1. Project Complete: Include as the last activity in the Project Schedule an activity called "Project Complete". "Project Complete" should be a finish milestone activity type and have a constraint of finish on or before. Use the end of the day of the Contract completion date for the constraint date and time. The schedule calculations shall result in a negative float when the calculated late finish date of the last activity is later than the contract completion date. The schedule shall have no constrained dates other than those specified in the Contract unless approved by the Owner.
 2. Just-in-Time Deliveries: The use of "As Late as Possible" constraint may be allowed for Owner's Procurement items with prior approval of the Owner. If the "As Late As Possible" constraint is used for the Owner's procurement, use a finish milestone activity type and an Activity ID that begins with a P for procurement so those activities are quickly recognized in the constraint list. For example, Activity ID would be P-1000 or P-1010, etc. Once an anticipated delivery date is known, it would be changed to a Finish On or After Constraint. Once the item has arrived on site, remove the constraint and replace with an actual date. Contractor procured items should have a submittal review and procure/deliver activities and not be constrained.
 3. Contractor may utilize "As Late as Possible" constraints for activities like Crane or Equipment Mobilization, Scaffold Erection, or other supporting type works that are needed to occur just prior to the start of the construction activity.
 4. Interim Completion Dates: Constrain contractually specified interim completion dates with a Finish On or Before constraint to show negative float when the calculated early finish

date of the last activity in that phase is later than the specified interim completion date. Use an activity type of finish milestone and put the activity in the Milestone Grouping.

5. Open Ended Logic: There shall only be two open ended activities. The activity Start Project/Notice to Proceed will have no predecessor logic and the activity Project Complete will have no successor logic.
- D. Required Schedule Mechanics.
1. Activity IDs: Do not use smart coding other than MS for Milestone, C for Construction, S for Submittals, P for Owner Procurement or Procurement that does not require a submittal. Any prefix used will be followed by a dash. For example: MS-1000, MS-1010, C-1000, C-1010. Increment ID by 10.
 2. Once the Project Baseline has been established, do not delete any activities from the master schedule. If an activity no longer applies, add the word "DELETED" in the activity description and move to a Deleted activities group.
 3. Once the Project Baseline has been established, do not change any Activity ID unless approved by Owner.
 4. Description: Preface with an abbreviation of the location followed by a color followed by a verb and noun. Example: FL1: Install Tile, FL2: Install Windows. Do not change any activity description without Owner permission.
 5. Out-of-Sequence Progress: Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence Progress) must be corrected weekly and documented in the monthly narrative. The schedule software's F9 report lists these out-of-sequence activities.
 6. Negative Lags and Start to Finish Relationships: Lag durations contained in the project schedule shall not have a negative value. Do not use Start to Finish (SF) relationships.
 7. Calculation Mode: Schedule calculations shall retain the logic between predecessors and successors even when the successor activity starts and the predecessor activity has not finished. Software features that in effect sever the tie between predecessor and successor activities when the successor has started and the predecessor logic is not satisfied ("progress override") will not be allowed.
 8. Default Progress data is not allowed. Do not automatically update Actual Start and Finish dates with default mechanisms that may be included in the scheduling software. Enter the actual Start and Finish date of each activity in the Actual Start (AS) and Actual Finish (AF) dates field.
 9. Start and Finish Dates: Accurately show the status of the AS and/or AF dates for each activity currently in progress or completed since the last update. The Owner may allow an AF date to be assigned with the percent complete less than 100 percent to account for the value of work remaining but not restraining successor activities. Only assign AS dates when actual progress occurs on an activity.
 10. Remaining Duration: Update the estimated Remaining Duration for all in progress activities independent of Percent Complete.
 11. Percent Complete: Update the percent complete for each activity started based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete.
 12. Ownership of Float: Float available in the schedule at any time shall not be considered for the exclusive use of either the Owner or the Contractor. The Owner Controlled Float activities are for the exclusive use of the Owner. If the Contractor puts in a Contractor Controlled Float activity, it will be for the Contractor's exclusive use only.
- E. Required Activities and Level of Detail Required: Develop the Project Schedule to an appropriate level of detail. Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. The Owner will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail:
1. Include tasks for the following:
 - a. "Prepare, Submit" and "Review, Approve" for all submittals.

- b. Include O&M Manuals and as-built drawings.
 - c. 3rd party Inspections, if requested by the Owner.
 - d. Permits. Allow a minimum of 40 calendar days for the "Review, Issue" of each permit. Coordinate with the Owner the anticipated duration.
 - e. Procurement, Construction, Commissioning Activities: Coordinate punch list and commissioning sequence with Owner.
 - f. "Prepare, Submit", "Review, Approve" and "Procure, Fab and Deliver" of long lead or major materials, equipment, etc.
 - g. Owner's Activities, include, but are not limited to, reviews, approvals, inspections, Owner Furnished Equipment (OFE), and Notice to Proceed (NTP), etc.
2. Contractor and Subcontractor Summary Level of Effort Activities: Include a level of effort activity for the Contractor in the Baseline Schedule. Include a level of effort activity for each subcontractor at the time their period of performance has been established. In the activity description include the Contractor's or subcontractor's name and their performance period in days or weeks. The level of effort should be a start to start with their first activity and a finish to finish with their last activity. Create a grouping in the milestones and Summaries Grouping for the Subcontractor Summary and include these level of effort activities in it.
 3. Milestones: The schedule must include start and finish milestones, all contractual milestones and any interim milestones specified by the Owner.
 4. Early Project Completion: In the event the Baseline or Progress Update Schedule calculates an early completion date of the last activity to the Contract Completion date and the schedule calculates positive float, the Contractor shall include an activity named "Contractor Contingency" with no cost and a duration equal to the number of calendar days from the date all the contract work is planned to be completed to the official contract completion date as awarded. This activity should only be adjusted on the monthly update.
 5. No activity should have more than one responsible party except in the cases where a single entity is responsible for executing all portions of the work.

2.04 SCHEDULE - DRIVEN REQUIREMENTS

- A. A schedule for the purchase, delivery, and receipt of critical items required for performance of the Work, showing lead times between purchase order placement and delivery dates, shall be integrated with the Construction Progress Schedule. Neither the Architect nor the Owner shall be deemed to have approved or accepted any such material, or its schedule, nor deemed to have waived this requirement if some or all of the material is not received.
- B. Should the Contractor fail to meet any scheduled date as shown on the current Construction Progress Schedule, the Contractor shall, if requested, be required at its own expense to submit within ten days of the request an updated Construction Progress Schedule. If the Contractor's progress indicates to the Owner that the Work will not be Substantially Completed within the Contract Time, the Contractor shall, at its own expense, increase its work force and/or working hours to bring the actual completion dates of the activities into conformance with the Construction Progress Schedule and Substantial Completion within the Contract Time. The Contractor shall reschedule and also submit a revised Construction Progress Schedule at its own expense within ten days of notice from the Architect that the sequence of work varies significantly from that shown on the current Schedule showing work to complete on original Contract Time with approved extensions. Neither the Owner nor the Architect will, however, be obligated to review the substance or sequence of the Construction Progress Schedule or otherwise determine whether it is correct, appropriate or attainable.
- C. Schedule Float Utilization:
 1. Any float time to activities not on the critical path shall belong to the Project, and may be used by the Project to optimize its construction process. Any float time between the end of the final construction activity and the final completion date shall belong to the Owner, and may be used by the Owner in determining if additional contract days are to be awarded for changes in the contract or for delays to the contract caused by the Owner. The Contractor will not be entitled to any adjustment in the Contract Time, the Construction Schedule, or

the Contract Sum, or to any additional payment of any sort by reason of the Owner's use of float time between the end of the final construction activity and the final completion date or by reason of the loss or use of any float time, including time between the Contractor's anticipated completion date and end of the Contract Time, whether or not the float time is described as such on the Construction Progress Schedule.

2.05 REPORTS

- A. Progress Report: At weekly intervals, report on progress and quality of the Work performed on a daily basis.
 - 1. Written progress reports shall include, at a minimum:
 - a. Project name.
 - b. Date.
 - c. Author of report.
 - d. Weather conditions including wind, precipitation and temperature.
 - e. Trades present through the reporting period.
 - f. Materials and equipment delivered, utilized and/or stored on site.
 - g. Conformance with Contract Documents and/or any observed deviations.
 - h. Conformance with or deviation from Construction Schedule.
 - i. Conformance with or deviation from Contract Sum.
 - j. Outstanding RFIs (e-Builder RFI log).
 - k. Outstanding submittals (e-Builder Submittal Log).
 - l. Test and/or inspections performed inclusive of results or a log that identifies inspections performed and any non-compliant issues identified.
 - m. List of site visitors, including regulatory agencies and/or testing and inspection entities.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.06 SPECIAL REPORTS

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

PART 3 EXECUTION

3.01 REVIEW AND EVALUATION OF SCHEDULE

- A. Participate in joint review and evaluation of schedule with Owner and Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.

3.02 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.

- C. Update diagram to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

3.03 DISTRIBUTION OF SCHEDULE

- A. Distribute copies of updated schedules to Contractor's project site file, to Subcontractors, suppliers, Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Quality assurance submittals.
- B. Control of installation.
- C. Manufacturers' field services.

1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittal procedures.
- B. Section 01 42 16 - Definitions.
- C. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

1.03 SUBMITTALS

- A. Shop Drawings: For integrated exterior mock-ups, provide plans, sections, and elevations, indicating materials and size of mock-up construction.
 - 1. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
- B. Testing and Inspection Plan: Submit for Owner's and Architect's knowledge.
 - 1. Provide copies to Owner's testing and inspection agencies and authorities having jurisdiction.
- C. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
 - 1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- D. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- E. Manufacturer's Field Reports: Submit reports in quantities specified for Product Data.
 - 1. Submit report within 30 days of observation to Architect for information.
- F. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility, in accordance with Section 1709.1 of the Oregon Structural Specialty Code, sent to authorities having jurisdiction and the Owner before starting work on the following systems.
 - 1. Seismic-force resisting system, designated seismic system, or component listed in the designated seismic systems and seismic-force-resisting systems statement of inspections indicated on the Structural Drawings.
 - 2. Main wind-force resisting systems and wind-resisting components listed in the wind-force-resisting systems statement of special inspections indicated on the Structural Drawings.
- G. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.04 DEFINITIONS

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

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

1.05 CONFLICTING REQUIREMENTS

- A. Metal Thickness: Where thickness of metals is designated in both gage and thickness in inches, the thickness in inches shall govern. Gages are provided for convenience only. Specified submittals for metals shall indicate thicknesses in inches.

1.06 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

1.07 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer's Field Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- C. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 1. Name, address, and telephone number of technical representative making report.

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

3.03 DEFECT ASSESSMENT

- A. When tests or inspection indicate non-compliance with the Contract Documents, subsequent retesting occasioned by such noncompliance shall be performed by the same personnel as performed the initial tests or inspections, and the additional cost shall be paid by the contractor as stipulated under the Conditions of the Contract.
- B. Contractor shall remove and replace any work found defective or not in compliance with the Contract Documents at no additional cost to Owner, and furnish notice for retesting as specified herein above.
- C. Replace Work or portions of the Work not conforming to specified requirements.
- D. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

3.04 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
- B. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

**SECTION 01 40 05
CUTTING AND PATCHING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements and limitations for cutting and patching of the Work.

1.02 RELATED REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.
- B. Section 01 70 00 - Execution: Examination, preparation, and general installation procedures.

1.03 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
- B. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Submit written request in advance of cutting or alteration which affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather-exposed or moisture-resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight-exposed elements.
 - 5. Work of Owner or separate contractor.
- C. Include in request:
 - 1. Identification of Project.
 - 2. Location and description of affected work.
 - 3. Necessity for cutting or alteration.
 - 4. Description of proposed work, and products to be used.
 - 5. Alternatives to cutting and patching.
 - 6. Effect on work of Owner or separate contractor.
 - 7. Written permission of affected separate contractor.
 - 8. Date and time work will be executed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00.

PART 3 EXECUTION

3.01 GENERAL

- A. Execute cutting, fitting, patching and finishing including excavation and fill, to complete Work, and to:
 - 1. Fit the several parts together, to integrate with other work.
 - 2. Uncover work to install ill-timed work.
 - 3. Match work that has been cut to adjacent work.
 - 4. Repair areas adjacent to cuts to required condition.
 - 5. Repair new work damaged by subsequent work.
 - 6. Remove and replace defective and non-conforming work.

7. Remove samples of installed work for testing.
8. Provide openings in elements of Work for penetrations of mechanical and electrical work.
9. Provide finished appearance of surfaces and to match adjacent surfaces (unless otherwise noted) affected by the Work.

3.02 INSPECTION

- A. Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- B. After uncovering, inspect conditions affecting performance of work.
- C. Beginning of cutting or patching means acceptance of existing conditions.
- D. Review District's current AHERA Management Plan and the Hazardous Materials Survey included in the Project Manual to become aware of any asbestos containing materials or lead containing painted surfaces that may be impacted prior to the execution of the Work.
 1. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the Work.

3.03 PREPARATION

- A. Provide supports to assure structural integrity of surroundings; devices and methods to protect other portions of Project from damage.
- B. Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations. Maintain excavations free of water.
- C. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.04 PERFORMANCE

- A. Execute work by methods to avoid damage to other work, and which will provide proper surfaces to receive patching and finishing.
- B. Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- C. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. When possible, remove existing materials back to joints or break points. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 5. Roofing: At locations where existing roofing must be removed to accommodate new construction, remove roofing, including insulation as necessary. Provide a temporary cutoff in strict accordance with roofing manufacturer's recommendations, to provide a 100 percent watertight seal.
 - a. If any water is allowed to enter under the existing roofing, the affected area shall be removed and replaced at Contractor's expense.
- D. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as

practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.
 2. Match color, texture, and appearance.
 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.
 4. Replacement of defective work will not create new seams or joint lines.
 5. Restore work with new products in accordance with requirements of Contract Documents.
 6. Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
 7. At penetrations of fire-rated wall, ceiling, or floor construction, completely seal voids with fire-rated material, full thickness of the construction element.
- E. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements. Materials subject to testing and inspection in the specifications shall be retested after cutting and patching operations are completed.

END OF SECTION

SECTION 01 42 16
DEFINITIONS

PART 1 GENERAL

1.01 SUMMARY

- A. This section supplements the definitions contained in the General Conditions.
- B. Other definitions are included in individual specification sections.

1.02 SPECIFICATION EXPLANATION

- A. The specifications are divided into Divisions and Sections for the convenience of writing and using. The titles of these are not intended to imply a particular meaning or to fully describe the work of each division or section, and are not an integral part of the text which specifies the requirements. The Architect is not bound to define the limits of any subcontract, and will not enter into disputes between the Contractor and its employees, including subcontractors.
- B. These specifications are of the abbreviated or "streamlined" type and include incomplete sentences. Words and meanings shall be interpreted as appropriate. Words that are implied, but not stated, shall be interpolated as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
- C. Omissions of words or phrases shall be supplied by inference in the same manner as they are when a "note" occurs on the drawings.
- D. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

1.03 DEFINITIONS

- A. The definitions in this Section are not necessarily complete or exclusive but, generally, apply to all portions of the Work. Some contractual definitions appear in the General Conditions. Definitions of words of a special nature which relate to Work covered in one or two Sections of the Specifications are included in such Sections. Terms used throughout the Contract Documents are defined in this Section.
- B. Approve: Where used in conjunction with the Architect's or Engineer's response to submittals, requests, applications, inquiries, reports, and claims by the Contractor, the meaning of the term "approved" will be held to the limitations of the Architect's responsibilities and duties as specified in the General and Supplementary Conditions. In no case will "approval" by the Architect be interpreted as an assurance to the Contractor that the requirements of the Contract Documents have been fulfilled. The term "or approved" used in conjunction with specified materials means "properly submitted and approved substitution request."
- C. Coordinate: The term "coordinate" means satisfactorily combine the work of all trades for a complete and operating installation.
- D. Directed, Requested, etc.: Unless otherwise explained, terms such as "directed", "requested", "authorized", "selected", "approved", "required", "accepted", and "permitted" mean "directed by the Architect", "requested by the Architect", etc. However, no such implied meaning will be interpreted to extend the Architect's responsibility into the Contractor's area of construction supervision.
- E. Furnish: Except as otherwise defined in greater detail, the term "furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.
- F. General Requirements: The provisions or requirements of Divisions 01 Sections apply to entire work of Contract and, where so indicated, to the other elements of work which are included in the Project.
- G. Guarantee and Warranty: "Warranty" is generally used in conjunction with products manufactured or fabricated away from the project site, and "guarantee" is generally used in

conjunction with units of work which require both products and substantial amounts of labor at the project site. The resulting difference is that warranties are frequently issued by manufacturers and frequently supported (partially) by product guarantees from contractors and/or installers.

- H. Indicated: A cross reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in the Contract Documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.
- I. 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.
- J. Installer: The person or entity engaged by the Contractor or his Subcontractor or Sub-subcontractor for the performance of a particular unit of work at the project site, including installation, erection, application and similar required operations. It is a general requirement that Installers be recognized experts in the work they are engaged to perform.
- K. Product: The term "product" as used in the Project Manual includes materials, systems, and equipment provided by the Contractor for use in the Work.
- L. Project Manual: The term "Project Manual" is the volume which includes the Bidding Requirements, Conditions of the Contract, and the Specifications, Divisions 01 through 33 inclusive, as applicable, and as listed in the Table of Contents bound therein.
- M. Provide: Except to the extent further defined, the term "provide" means to furnish and install, complete and ready for the intended use.
- N. Selected: The term "selected" means "selected by the Architect and Owner"; the Architect shall be the sole judge of the acceptability of a product or an installation.
- O. Site: Space available to the Contractor for performing the Work under this Contract, either exclusively or in conjunction with other contractors as part of the overall Project. The Site may be unimproved vacant land, an existing building or space within an existing building. The extent of the Site is shown on the Drawings.
- P. Specification Language: Imperative language is used, generally, throughout the Specifications. Requirements expressed imperatively are to be performed by the Contractor. For clarity at certain locations, contrasting subjective language is used to describe responsibilities which must be performed by the Contractor or, when so noted, will be performed by others.
- Q. Trades: Using terms such as carpentry is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as carpenter. It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 60 00
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufacturer's standard warranties and special warranties.
- B. General product requirements.
- C. Re-use of existing products.
- D. Transportation, handling, storage and protection.
- E. Product option requirements.
- F. Substitution limitations and procedures.
- G. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittal requirements and electronic submission requirements.
- B. Section 01 40 00 - Quality Requirements: Product quality monitoring.

1.03 SUBMITTALS

- A. Proposed Products List: Electronically submit list of major products and list of finish materials proposed for use, with name of manufacturer, trade name, and model number of each product.
 - 1. Submit within 15 days after date of Agreement.
 - 2. For products specified only by reference standards, list applicable reference standards.
 - 3. Indicate product lead times.
- B. Substitution Requests: Electronically submit each request for consideration as a PDF. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Name of PDF shall reflect the specification Section number and the proposed product manufacturer or product name.
 - 2. Limit each request to one proposed substitution.
 - 3. Submit a separate form for each item upon which approval is requested, with the exception of groups of items (e.g., electrical fixtures, plumbing fixtures, etc.) for which an itemized listing may be attached.
 - 4. Acceptance of the particular product or method on a previous project does not confer or imply acceptance for this project.
 - 5. Submit samples to Architect upon request.
 - 6. All substitutions must be initiated and approved using the District mandated work flow process. Refer to Section 01 31 23 - Project Management Database (PMD).
- C. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- E. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

1.04 QUALITY ASSURANCE

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
- D. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- E. Neither the contractual relationships, duties, nor responsibilities of the parties in Contract nor those of the Architect shall be altered by the Contract Documents by mention or inference otherwise in any reference document.
- F. Contractor warrants to the Owner that the materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of material and equipment.

1.05 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Refer to Divisions 02 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00 - Closeout Procedures.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

- D. Reused Products: Reused products include materials and equipment previously used in this or other construction, salvaged and refurbished as specified.
- E. Specific Products to be Reused: The reuse of certain materials and equipment already existing on the project site is required.
 - 1. See Section 02 41 00 - Demolition for list of items required to be salvaged for reuse and relocation.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.
 - 1. Means new material, machinery, components, equipment, fixtures, and systems comprising the Work. Does not include machinery and equipment used for preparation, fabrication, conveying, and erection of the Work.
 - 2. Products may also include existing materials or components when specifically designated for reuse.
- B. DO NOT USE products having any of the following characteristics:
 - 1. Made using or containing CFC's or HCFC's.
 - 2. Made of wood from newly cut old growth timber.
- C. Where all other criteria are met, Contractor shall give preference to products that:
 - 1. Are extracted, harvested, and/or manufactured closer to the location of the project.
 - 2. Have longer documented life span under normal use.
 - 3. Result in less construction waste.
 - 4. Are made of vegetable materials that are rapidly renewable.

2.03 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Two or more items of the same kind shall be considered identical and by the same manufacturer.
 - 4. Provide products suitable for service conditions.
 - 5. Adhere to equipment capacities, sizes and dimensions shown or specified unless variations are specifically approved in writing.
 - 6. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 7. Where products are accompanied by the term "as selected," Architect will make selection.
 - 8. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

2.04 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming Products of More than One Manufacturer: Use one of the products named and meeting specifications, no options or substitutions allowed.
- D. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.
- E. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a

comparable product by one of the other named manufacturers. Submit a request for substitution for other named manufacturers. Use of manufacturers not named not allowed.

- F. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements for substitutions
- G. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.05 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

- A. No substitution will be considered prior to receipt of Bids unless the Architect receives a written request for approval at least seven days prior to the date for receipt of Bids. Comply with requirements specified in this section. Requests received after that time will not be considered except as specified below under "Substitutions Requested After Award of Contract."
- B. Submit all requests for substitutions electronically as PDFs.
 - 1. Submit all requests for substitutions during the Bid Phase via email to the individual indicated in Instructions to Bidders.
 - 2. Submit all requests for substitutions after the Bid Phase in accordance with requirements for electronic submittals in Section 01 30 00 - Administrative Requirements.
 - 3. Submit all requests for substitutions after the Bid Phase through the Contractor. Substitution requests received directly from Subcontractors or Suppliers will be returned through the Contractor without review.
- C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
- D. A request for substitution constitutes a representation that the Contractor/Bidder:
 - 1. Has investigated proposed product and determined that it is equal to or superior in all respects to specified product.
 - 2. Will provide identical warranty as required for the specified product.
 - 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 5. Will pay for changes to building design, including architectural or engineering design, detailing, construction costs, or re-approval by authorities caused by the requested substitution.
- E. Substitutions after Award of Contract will not be considered when:
 - 1. Indicated or implied on shop drawings or product data submittals without formal request submitted in accordance with this Section.
 - 2. Submittal for substitution request has not been reviewed and recommended by Contractor. Substitution requests received directly from Subcontractors or Suppliers will be returned through the Contractor without review.
 - 3. Acceptance will require substantial revision of Contract Documents or other items of the Work.

4. Submittal for substitution request does not include point-by-point comparison of proposed substitution with specified product.
- F. Substitution Request Form:
1. Use Substitution Request Form bound at the end of this Section for substitution requests during the bid phase.
 2. Use "Substitution Request (After the Bidding Phase)" form bound at the end of this Section for substitution requests after the Award of Contract.
- G. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
1. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 2. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 3. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 4. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 5. Samples, where applicable or requested.
 6. Certificates and qualification data, where applicable or requested.
 7. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 8. List of availability of maintenance services and replacement materials.
 9. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 10. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 11. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 12. Cost information, including a proposal of change, if any, in the Contract Sum.
 13. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 14. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
- H. Accepted Substitutions prior to Bid Date will be listed in Addenda published in accordance with Advertisement for Bids and the Instructions to Bidders. Bidders will not rely upon approvals made in any other manner.
- I. Architect's Action for Substitutions After Award of Contract: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
1. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 2. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

3.02 SUBSTITUTIONS REQUESTED AFTER AWARD OF CONTRACT

- A. Substitutions will normally not be considered after date listed in Instructions to Bidders, except when required due to unforeseen circumstances. Within a period of 15 days after date of Contract, the Owner may, at its option, consider formal written requests for substitution of products in place of those specified when submitted in accord with the requirements stipulated herein. To receive consideration, one or more of the following conditions must be documented in any such request:
 - 1. The substitution is required for compliance with final interpretation of Code requirements or insurance regulations.
 - 2. The substitution is required due to unavailability of a specified product, through no fault of the Contractor.
 - 3. The substitution is required because subsequent information disclosed the inability of the specified product to perform properly or to fit in the designated space.
 - 4. Manufacturer's or fabricator's refusal to certify or warrant performance of specified product as required.
 - 5. Subsequent information that a long delivery date will not be compatible with the Contract construction period.
 - 6. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
- B. District reserves the right to reject any and all substitution requests for any reason, without obligation or liability.

3.03 TRANSPORTATION AND HANDLING

- A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- B. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
- C. Transport and handle products in accordance with manufacturer's instructions.
- D. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- E. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- F. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- G. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store materials in a manner that will not endanger Project structure.
- C. Store and protect products in accordance with manufacturers' instructions.
- D. Store with seals and labels intact and legible.
- E. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- F. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

SECTION 01 60 00
PRODUCT REQUIREMENTS

- G. For exterior storage of fabricated products, place on sloped supports above ground.
- H. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- J. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- K. Prevent contact with material that may cause corrosion, discoloration, or staining.
- L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SUBSTITUTION REQUEST FORM

TO: <Insert Design Firm Name and Address>

PROJECT: <Insert Project Name>

We hereby submit for your consideration the Product described below as a substitute for the specified product indicated:

1. Specified Product:

Name: _____

Section: _____ Paragraph: _____

2. Proposed Substitution:

a. Brand Name: _____

b. Model/Catalog No.: _____

c. Manufacturer: _____
(Name)

(Address) (Zip) (Telephone)

d. Nearest Distributor: _____
(Name)

(Address) (Zip) (Telephone)

e. Substitute product effects adjacent Work in the following way:

3. Supporting Data:

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

b. Attached data also includes description of changes to Contract Documents which proposed substitution will require for its proper installation.

4. Certification:

The undersigned certifies that the following paragraphs, unless modified on attachments, are correct:

- a. The proposed substitution does not affect dimensions shown on Drawings.
- b. The undersigned will pay for changes to the building design, including engineering design, detailing and construction costs caused by the requested substitution.

SUBSTITUTION REQUEST FORM

- c. The proposed substitution will have no adverse affect on other trades, the construction schedule, or specified warranty requirements.
- d. Maintenance and service parts will be locally available for the proposed substitution.
- e. The function, appearance and quality of the proposed substitution are equal or superior in all respects to the product specified.

5. Submitted By:

Firm: _____
(Name)

(Address) (Zip) (Telephone)

By: _____ Title: _____
(Please type or print)

Signature: _____

6. Acceptance/Rejection:

Acceptable substitution items will be covered by an Addendum issued to all Bidders.

7. Architects Action:

The following is for use by the Architect:

- | | |
|---------------------------------------|--|
| <input type="checkbox"/> Accepted | <input type="checkbox"/> Accepted with exceptions as noted |
| <input type="checkbox"/> Not Accepted | <input type="checkbox"/> Received after deadline |

Remarks: _____

By: _____ Date: _____

For: <Insert Design Firm Name>

END OF FORM

**SUBSTITUTION
REQUEST**
(After the Bidding Phase)

Project: _____ Substitution Request Number: _____

From: _____
To: _____ Date: _____

Architect Project Number: _____
Re: _____ Contract For: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
Manufacturer: _____ Address: _____ Phone: _____
Trade Name: _____ Model No: _____
Installer: _____ Address: _____ Phone: _____
History: New Product 2-5 years old 5-10 years old More than 10 years old
Differences between proposed substitution and specified product: _____

Point by Point comparative data attached - REQUIRED

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____
Address: _____ Owner: _____
Date Installed: _____

Proposed substitution affects other parts of Work: No Yes, explain _____

Savings to Owner for accepting substitution: _____ (\$ _____).

Proposed substitution changes Contract Time: No Yes [Add] [Deduct] _____ days

Supporting Data Attached:

Drawings Product Data Samples Tests Reports _____

**SUBSTITUTION
REQUEST**
(After the Bidding Phase)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
 - Same warranty will be furnished for proposed substitution as for specified product.
 - Same maintenance service and source of replacement parts, as applicable, is available.
 - Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
 - Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
 - Proposed substitution does not affect dimensions and functional clearances.
 - Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
 - Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.
-

Submitted by: _____
Signed by: _____
Firm: _____
Address: _____

Telephone: _____
Attachments: _____

REVIEW AND ACTION

- Substitution approved - Make submittals in accordance with Specification Section 01 30 00.
- Substitution approved as noted - Make submittals in accordance with Specification Section 01 30 00.
- Substitution rejected - Use specified materials.
- Substitution Request received too late - Use specified materials.

Signed by: _____ Date: _____

Additional Comments: Contractor Subcontractor Supplier Manufacturer A/E _____

SECTION 01 70 00
EXECUTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Protection of installed construction.
- C. Correction of the Work.
- D. Progress cleaning.

1.02 RELATED REQUIREMENTS

- A. Section 01 45 05 - Field Engineering: Construction layout.

1.03 REFERENCE STANDARDS

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.05 PROJECT CONDITIONS

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where applicable, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Examine roughing-in for mechanical, plumbing, fire suppression and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - a. Verify that utility services are available, of the correct characteristics, and in the correct locations.
 - 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - a. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
 - 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings in substrate prior to applying next material or substance.

- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.
- D. Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication.
- E. Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- F. Review Contract Documents and field conditions. Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Section 01 30 00 - Administrative Requirements.

3.03 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations and ground floor elevations.
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.
- J. Provide evidence of completion of clash detection with other trades prior to commencement of work.

3.04 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
 - 2. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
 - 3. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
 - 4. Make neat transitions between different surfaces, maintaining texture and appearance.
 - 5. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 6. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 - 7. The Architect may make minor adjustments in fixture, outlet, grille, louver, or ventilator locations prior to rough-in work with no additional cost.
- B. Installer Inspections: Require installer of each major unit of work to inspect substrate and conditions for installation and to report unsatisfactory conditions in writing.
 - 1. Correct unsatisfactory conditions before proceeding with installation.
 - 2. Inspect each product immediately before installation.
 - 3. Do not install damaged or defective products, materials or equipment.

4. Start of installation shall be understood as acceptance of substrate conditions by the installer.
- C. Clearances: Provide adequate clearance between Architectural, Structural, Mechanical and Electrical systems. Verify physical dimensions of equipment and its available space. Check access routes through concealed or existing spaces for installation of systems or equipment.
 1. Review the Contract Documents for possible conflicts prior to rough-in. Verify that equipment will fit in the space provided. Resolve conflicts with the Architect prior to rough-in work.
- D. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- E. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- F. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- G. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- H. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- I. Attachment: Provide blocking, attachment plates, anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- J. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- K. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.05 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.
 3. Where applicable, review and verify with Owner any required blocking and associated components required for installation of products prior to covering components.
 4. Refer to Section 01 10 00 - Summary for additional requirements.

3.06 PROTECTION OF INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual specification Sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to minimize damage.
- C. Provide and maintain temporary shoring and lateral bracing of structure during erection to resist all loads including:
 - 1. Wind
 - 2. Seismic
 - 3. Construction
 - 4. Materials
 - 5. Moving equipment
- D. Do not remove temporary bracing and shoring until adequate, permanent connections or structural elements are in final position and positively anchored.
- E. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- F. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- G. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- H. Prohibit traffic from landscaped areas.
- I. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- J. Comply with manufacturer's written instructions for temperature and relative humidity.

3.07 CORRECTION OF THE WORK

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

3.08 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Utilize containers intended for holding waste materials of type to be stored.
 - 4. Daily cleaning shall include magnetic sweep of jobsite to pick up all nails and metallic debris.
- B. Site: Maintain Project site free of waste materials and debris.

- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 74 19 - Construction Waste Management and Disposal.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

END OF SECTION

**SECTION 01 77 00
CLOSEOUT PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Substantial Completion.
- B. Final Completion.
- C. Punch List.
- D. Warranties.
- E. System startup.
- F. Adjusting.
- G. Final Cleaning.
- H. Maintenance.

1.02 RELATED REQUIREMENTS

- A. CM/GC General Conditions for Public Improvement: Progress Payments and Final Payment.
- B. Section 01 13 31 - Certificate of Compliance.
- C. Section 01 13 32 - Certificate of No Hazardous Materials.
- D. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance (O&M) data, warranties and bonds.
- E. Section 01 79 00 - Demonstration and Training: Requirements relating to Owner training prior to Closeout.

1.03 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting review for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
 - 1. In progress payment request coincident with or first following date claimed, show either 100 percent completion for portion of work claimed as "substantially complete", or list incomplete items, value of incompleteness, and reasons for being incomplete. Include supporting documentation for completion as indicated in these contract documents.
 - a. Submit statement showing accounting of changes to the Contract Sum.
 - b. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Submit workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 5. Submit completed Certificate of Compliance. Refer to Section 01 13 31.
 - 6. Submit completed Certificate of No Hazardous Materials. Refer to Section 01 13 32.
 - 7. Prepare and submit drafts for Operation and Maintenance Manuals.
 - 8. Prepare and submit drafts for Project Record Documents.
 - 9. Prepare and submit damage or settlement surveys, property surveys, and similar final record information. Update to existing survey by qualified land surveyor and include with record drawings.
 - 10. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable. Submit an itemized receipt, signed by Owner, to Architect.
 - 11. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.

12. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 13. Advise Owner and utility companies of changeover in heat and other utilities.
 14. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 15. Complete final cleaning requirements, including touchup painting.
 16. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
 17. Make submittals that are required by governing or other authorities.
 - a. Provide copies to Architect and Owner.
 - b. Provide copy of Occupancy Permit to Architect and Owner.
- B. Review: Submit a written request for review for Substantial Completion. On receipt of request, Architect will either proceed with review or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after review or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Results of completed review will form the basis of requirements for Final Completion.
 2. Should the Architect have to perform any additional reviews due to failure of Work to comply with claims of completion made by Contractor, the cost for each additional review will be charged to the Owner at the Architect/Engineer's hourly rate. The Owner shall have the right to deduct such charges from the contract amount as provided in the Conditions of the Contract.

1.04 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final review for determining final completion, complete the following:
1. Submit a final Application for Payment with final waivers according to Section 01 20 00 - Price and Payment Procedures.
 - a. Submit updated final statement, accounting for additional (final) changes to Contract Sum.
 2. Submit consent of surety.
 3. Prepare and submit final Project Record Documents within 30 days after date of Substantial Completion or before final completion, whichever occurs first.
 4. Submit final warranties.
 5. Submit final operation and maintenance manuals.
 6. Submit certified copy of Architect's Substantial Completion review list of items to be completed or corrected (punch list). The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 8. Submit permanent unconditioned Certificate of Occupancy.
 9. Submit payment and release of liens to requirements of General Conditions. Before final payment, the Contractor shall furnish the following to the Architect:
 - a. An affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner of property might in any way be responsible, have been paid or otherwise satisfied (use AIA Form G706 or approved by District).
 - b. An affidavit from each Subcontractor on AIA Form G706 or approved by District.
 - c. Letter from Bonding Company addressed to Owner but submitted to the Architect, approving release of final payment and waiving submission of final receipts as well as a statement confirming the extension of the Bond for the warranty period as specified. Final receipts from all Subcontractors and material and equipment suppliers may be required to furnish to the Owner by the Contractor if the Surety does not waive this requirement. Letters to be in substantially the following form:
(Name of Owner)Re: (Bond No.)

(Address)(Name of Contractor)

(Name of Project)

Gentlemen:

The (Name of Bonding Company), surety on the above named Bond, consents to payment of retained percentages and agrees to waive submission of final receipts.

It is also agreed that the final payment to the Contractor shall not relieve the Surety Company of any of its obligations and that the Bond is extended to include guarantees and warranties of workmanship and materials.

(NAME OF BONDING COMPANY)

Attorney-in-Fact

- d. Submit Contractor's Affidavit of Release of Liens (AIA Form G706A or approved by District).
 - e. Return all copies of the Drawings and Specifications in accordance with the General Conditions.
10. Submit Affidavit of Wages Paid for Contractor and all sub-contractors.
 11. Submit Employment Security Release.
 12. Submit Department of Revenue Release (for projects over \$35,000 only).
 13. Return to Owner all items issued during construction such as keys, security passes and identification badges.
 14. Complete startup testing of systems.
 15. Submit test/adjust/balance records.
 16. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
 17. Submit attendance record for training of Owner's personnel.
 18. Complete requirements of Section 01 78 00 - Closeout Submittals.
 19. Complete requirements of Section 01 79 00 - Demonstration and Training.
 20. Coordinate with Commissioning Authority and complete requirements of Section 01 91 13 - General Commissioning Requirements and the Commissioning Plan.
- B. Review: Submit a written request for final review for acceptance. On receipt of request, Architect will either proceed with review or notify Contractor of unfulfilled requirements. Architect will either prepare a letter to Owner recommending final acceptance or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Additional Reviews: Request an additional review when the Work identified in previous reviews as incomplete is completed or corrected.
 2. Should the Architect have to perform any such additional reviews due to failure of Work to comply with claims of completion made by Contractor, the cost for each additional review will be charged to the Owner at the Architect/Engineer's hourly rate. The Owner shall have the right to deduct such charges from the contract amount as provided in the Conditions of the Contract.
 3. Provide additional cleaning services as required for Work which was not complete at the time of initial review. Reclean as required until all Work is fully complete and recommended for final acceptance by Architect.
 4. If the Work does not achieve Final Completion within two weeks of the date originally scheduled to do so, plus any time adjustments by Change Order, the Architect's time and efforts beyond that period shall constitute extra services, the cost of which at the Architect's standard hourly rates will be deducted from the Contractor's Final Payment or retainage by the Owner.
 5. Punch list items in the Schedule of Values will be released on any given line item only when all punchlist items relating to that line item are satisfactorily completed.

1.05 CONTRACTOR'S LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Prior to requesting review for Substantial Completion, perform a thorough punch list of the project identifying incomplete items, damaged items and substandard items requiring correction.

1. Distribute the Punch List to applicable subcontractors and indicate corrections made to each item.
 2. Reinspect and sign off on all complete items.
 3. This Punch List will form the basis of the list to be submitted with the request for Substantial Completion.
 4. Supplement Punch List with valuation of incomplete items and reasons for being incomplete.
 5. Prepare Punch List in digital format acceptable to Architect.
- B. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. PDF electronic file.

1.06 WARRANTIES

- A. Submittal Time:
1. Submit summary of warranties included in the bid within seven days after Notice of Intent to Award Contract (Prior to Execution of the Contract). Indicate duration of each warranty and start date.
 2. Submit sample warranties as part of the project submittal process.
 3. Submit final warranties before requesting review for final acceptance.
- B. Comply with requirements of Section 01 78 00 - Closeout Submittals.

PART 2 PRODUCTS

2.01 MATERIALS

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

PART 3 EXECUTION

3.01 SYSTEM STARTUP

- A. Coordinate schedule for start-up and functional testing of various equipment and systems.
- B. Notify Engineer and Owner seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units and retest.

- H. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- I. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.02 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.
- B. Testing, adjusting, and balancing HVAC systems: See requirements of Division 23.

3.03 CLEANING PRIOR TO SUBSTANTIAL COMPLETION REVIEW

- A. At time of project close-out, clean or reclean the Work to the condition expected from a normal, commercial building cleaning and maintenance program.
- B. Complete the following cleaning operations before requesting the Architect's review for certification of Substantial Completion.
 - 1. Remove grease, dust, dirt, stains, manufacturer's labels, fingerprints, etc. from sight exposed surfaces.
 - 2. Remove non-permanent protection and labels.
 - 3. Wash and polish all interior and exterior glazing and mirrors.
 - 4. Repair, patch and touch-up marred surfaces.
 - 5. Clean heating and cooling ducts, blowers, coils, fixtures, equipment, piping, and grilles.
 - 6. Replace disposable air filters and clean permanent filters.
 - 7. Remove construction debris.
 - 8. Flush water systems and disinfect domestic water lines. Sanitize plumbing and food service facilities.
 - 9. Broom clean new exterior paved surfaces and walks. Vacuum clean interior carpeted surfaces and wet mop hard floor surfaces.
 - 10. Clean light fixtures and replace burned-out lamps and replace damaged lenses.
 - 11. Police yards and grounds.

3.04 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and anti-pollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting review for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.

- i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.
 - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grilles.
 - q. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection.
 - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fixtures to comply with requirements for new fixtures.
 - s. Leave Project clean and ready for occupancy.
2. Maintain in cleaned condition until Final Completion or Owner occupancy.

3.05 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

SECTION 01 78 00
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Manuals.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Section 01 77 00 - Closeout Procedures: Contract closeout procedures.
- C. Individual Product Sections: Specific requirements for operation and maintenance data.
- D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Record Drawings:
 - 1. Draft: Submit one copy of marked-up record prints in electronic color PDF format as well as an AutoCAD or Revit file, prior to request for review for Substantial Completion.
 - 2. Final: Submit three paper copy sets, an electronically scanned copy of marked up prints, in addition to the AutoCAD or Revit file(s) within 30 days of dated established for Substantial Completion or prior to request for review for final completion, whichever occurs first.
 - 3. Approved permit set of plans.
 - 4. Provide all electronic files and documents required by the BIM execution plan.
- B. Record Specifications:
 - 1. Draft: Submit one copy of marked-up copy of Project Manual in electronic color PDF format prior to request for review for Substantial Completion.
 - 2. Final: Submit three copies of marked-up copy of Project Manual and one electronically scanned copy within 30 days of date established for Substantial Completion or prior to request for review for final completion, whichever occurs first.
- C. Operation and Maintenance Manuals:
 - 1. Draft: Submit one copy of draft manuals in electronic color PDF format prior to request for review for Substantial Completion. Architect will review draft and return one copy with comments. Revise content of all document sets as required prior to final submission.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Final: Submit three sets of revised Manuals and an electronically scanned copy in final form prior to request for review for final completion.
- D. Warranties and Bonds:
 - 1. Submit a summary of warranties included in the bid within seven days after Notice of Intent to Award Contract (Prior to Execution of the Contract). Indicate duration of each warranty and start date.
 - 2. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 3. Draft: Submit as part of normal submittal process.
 - 4. Final: Submit final forms of warranties prior to request for review for final completion.
- E. PDF Format: Submit searchable hyper-linked PDF electronic files. File names shall clearly identify the Owner, project name, drawing or specification number and name and date. File name shall be established to list in the same order as identified in the Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one complete set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and Construction Change Directives.
 - 5. ASIs and responses to RFIs.
 - 6. Reviewed shop drawings, product data, and samples.
 - 7. Manufacturer's instruction for assembly, installation, and adjusting.
 - 8. Architect will provide one hard copy (if applicable) and one hyper-linked PDF electronic file of a conformed set of Contract Documents (both drawings and specifications), that have been extracted directly from the Revit model incorporating addenda for use by Contractor in developing and maintaining Record Drawings.
 - a. Architect will provide initial linking of the PDF including at a minimum:
 - 1) Hyperlinked Table of Contents for both drawings and specifications.
 - 2) Bluebeam studio (or approved other) initiated for use by project teams.
- B. The record documents shall include all disciplines of work whether changes occur or not. These documents, as well as the approved permit set of plans, shall be available to the Architect and Owner at the site and reviewed with them on a monthly basis. The record documents will be maintained by the Contractor and shall incorporate all updates from Subcontractors and their scope of work. Satisfactory maintenance of up-to-date record drawings on a monthly basis will be a requirement for approval of progress payments.
- C. The dynamic PDF will be used as the most current and up-to-date approved set of documents for access by the entire project team.
- D. Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.
- E. Record Drawings: Once received, continue to hyperlink the drawings and specifications to include at a minimum:
 - 1. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Addenda.
 - k. Changes made by Change Order or Construction Change Directive.
 - l. Changes made following Architect's written orders, including ASIs and responses to RFIs.
 - m. Details not on the original Contract Drawings.
 - n. Field records for variable and concealed conditions.
 - 1) Include pre-cover photographs of every room and include link to the dynamic PDF.

- o. Record information on the Work that is shown only schematically.
 - p. Drawing details linked within drawings, all building section details and other details will be linked within the interactive PDF to allow easy navigation.
 - 2. Record drawings shall include, as a minimum, the location and performance data on each piece of equipment, detailed configuration of duct and pipe distribution system, including sizes, and the terminal air and water design flow rates updated to show approved balancing of systems.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints. Bluebeam Studio, or approved other, shall be utilized for collaboration and approval of marked-up record documents.
 - 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Mark revisions and/or clarifications issued by Addenda, ASI, Construction Change Directive, Change Orders or responses to RFIs to reflect the change. Each such revision shall be graphically depicted to represent physical construction and clearly noted with the applicable Addenda, ASI, Change Order or RFI number. Notation of the Addenda, RFI, ASI, Construction Change Directive or Change Order number alone will not be acceptable. All originating documents shall be linked and accessible within the dynamic PDF drawings.
 - 7. Ensure entries are complete and accurate, enabling future reference by Owner.
 - 8. Scanned Drawings: After review of draft drawings by Architect, incorporate necessary changes and prepare a full set of scanned Contract Drawings and Shop Drawings on CD-ROM.
- F. Specifications: Legibly mark and record at each product section a description of actual products installed, including the following:
 - 1. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 2. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - 3. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals.
 - 4. Mark revisions and/or clarifications issued by Addenda, ASI, Construction Change Directive, Change Orders or responses to RFIs to reflect the change. Each such revision shall be graphically depicted to represent physical construction and clearly noted with the applicable Addenda, ASI, Change Order or RFI number. Notation of the Addenda, RFI, ASI, Construction Change Directive or Change Order number alone will not be acceptable.
 - 5. Format: Submit record Specifications as approved record PDF electronic file(s) of the Specifications.

3.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. Provide servicing and lubrication schedule, and list of lubricants required.
- G. Include manufacturer's printed operation and maintenance instructions.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Provide control diagrams by controls manufacturer as installed.
- K. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- L. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- M. Include test and balancing reports.
- N. Additional Requirements: As specified in individual product specification sections.
- O. Hold several meetings with Owner, Architect and Contractor to determine O&M data to be included and linked to the dynamic PDF.

3.04 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
- J. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Product data, shop drawings, and other submittals.
 - c. Operation and maintenance data.
 - d. Field quality control data.
 - e. Photocopies of warranties and bonds.
 - 4. Design Data: To allow for addition of design data furnished by Architect or others, provide a tab labeled "Design Data" and provide a binder large enough to allow for insertion of at least 20 pages of typed text.
- K. PDF Electronic File: After review of draft manuals, assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to Architect.
 - 1. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.
 - 2. Enable inserted reviewer comments on draft submittals.
 - 3. File Names and Bookmarks: Enable bookmarking of individual documents based upon file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel upon opening file.
 - 4. Incorporate O&M data to be included and linked to the dynamic PDF.

3.05 WARRANTIES AND BONDS

- A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
 - 1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

2. The Owner reserves the right to refuse to accept or pay for Work for the Project where a Special Warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- E. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Completion is determined.
- F. Verify that documents are in proper form and contain full information.
- G. Co-execute submittals when required.
- H. Retain warranties and bonds until time specified for submittal.
- I. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.
- J. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- K. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
 1. Product or work item.
 2. Installer of product or item, with name of principal, address, and telephone number.
 3. Describe the work provided by this installer/Subcontractor, under this Contract.
 4. Date of beginning of warranty or service and maintenance contract. (See General Condition's Warranty paragraph.)
 5. Duration of warranty or service maintenance contract.
 6. Information for Owner's personnel, including:
 - a. Proper procedure in case of failure.
 - b. Contact phone numbers of manufacturer.
 7. Instances that might affect validity of warranty or bond.
 8. Contractor, name of responsible principal, address, and telephone number.
- L. Schedule of Warranties: Provide a summary schedule of start and end date of each warranty.
- M. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION

SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. HVAC systems and equipment.
 - 2. Electrical systems and equipment.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
 - 1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
 - 2. Finishes, including flooring, wall finishes, ceiling finishes.
 - 3. Fixtures and fittings.
 - 4. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

- A. Section 01 78 00 - Closeout Submittals: Operation and maintenance manuals.
- B. Section 01 91 13 - General Commissioning Requirements: Additional requirements applicable to demonstration and training.
- C. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures; except:
 - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
 - 2. Submit one copy to the Commissioning Authority, not to be returned.
 - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
 - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, most current version of Microsoft Word preferred.
- B. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
 - 1. Include applicable portion of O&M manuals.
 - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.
- C. Training Reports:
 - 1. Identification of each training session, date, time, and duration.
 - 2. Sign-in sheet showing names and job titles of attendees.
 - 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
 - 4. Include Commissioning Authority's formal acceptance of training session.

1.04 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

- A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.
- B. Conduct training on-site unless otherwise indicated.
- C. Owner will provide classroom and seating at no cost to Contractor.
- D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
- E. Provide training in minimum two hour segments.
- F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.
- G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 - 3. Typical uses of the O&M manuals.
- I. Product- and System-Specific Training:
 - 1. Review the applicable O&M manuals.
 - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
 - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 - 6. Discuss common troubleshooting problems and solutions.
 - 7. Discuss any peculiarities of equipment installation or operation.

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DEMONSTRATION AND TRAINING

8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 10. Review spare parts and tools required to be furnished by Contractor.
 11. Review spare parts suppliers and sources and procurement procedures.
- J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 23 00 00
BASIC HVAC REQUIREMENTS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. This Section specifies the basic requirements for all Contractor installed equipment. It applies to all sections included in Division 23. The requirements herein are an expansion upon the requirements of Division 1.
- B. Provide all materials, labor and equipment required to install complete and fully operational HVAC systems as indicated by the contract drawings and this specification.
- C. Obtain and pay for all permits, licenses, fees and taxes applicable to this project as required by law.
- D. Cooperate with other trades in furnishing material and information required for installation and operation of mechanical items.
- E. Requirements for the following are included:
 - 1. Related work (other Contract Documents and specification sections) that must be combined with the requirements of this Section.
 - 2. Design performance.
 - 3. Delivery, storage, and handling.
 - 4. Quality assurance and standards.
 - 5. Submittals.
 - 6. Product quality, basic type, and finishes.
 - 7. Equipment identification.
 - 8. Design criteria.
 - 9. Installation.
 - 10. Mounting and shimming.
 - 11. Inspection.
 - 12. Safety considerations.
 - 13. Cleaning, startup, and adjustments.

1.02 RELATED WORK

- A. This general section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for the project equipment and systems:
 - 1. Division 1 sections included in this Project specifications.
 - 2. The Contract.
 - 3. General and specific mechanical specifications and drawings included in the project.

1.03 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions.

1.04 DESIGN PERFORMANCE

- A. Compliance by the Contractor and/or Vendor with the provisions of this Specification does not relieve him of the responsibilities of furnishing equipment and materials of proper design, mechanically suited to meet operating guarantees at the specified service conditions.

1.05 SUBMITTALS

- A. Product Data: Refer to Section 01 60 00 - Product Requirements.
- B. Operation and Maintenance Data: Refer to Section 01 78 00 - Closeout Submittals.
- C. Air Balancing Report: Provide .PDF reports stating the design air and hydronic flow requirements per, air inlet and air outlet and the final adjusted airflow volume for the same.

1.06 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, standards and specifications, except where more stringent requirements are shown or specified:
 - 1. State of Oregon "IBC".
 - 2. State of Oregon "IMC".
 - 3. State of Oregon "UPC".
 - 4. State of Oregon "IFC".
 - 5. ANSI/ASHRAE 90 - "Energy Efficient Design of New Buildings...."
 - 6. ANSI/ASHRAE 62 - "Ventilation for Acceptable Indoor Air Quality."
 - 7. NEBB - "Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems."
 - 8. ANSI B31.9 "Building Service Piping".
 - 9. SMACNA - "HVAC Duct Construction Standards".
 - 10. NFPA - Section 90B.
- B. Drawings: All drawings are diagrammatic and show general design, arrangement, and extent of the systems. Do not scale drawings for rough-in dimensions, nor use as shop drawings.
- C. Installer Qualifications: Company specializing in performing the work required with a minimum of five years documented experience.
- D. Contractor shall furnish and install all work in accordance with manufacturers' recommendations and instructions.

1.07 DELIVERY, STORAGE AND PROTECTION

- A. Delivery: Deliver to site with manufacturer's labels intact and legible.
- B. Preparation for shipment:
 - 1. Each unit shall be suitably prepared for the shipment specified and for storage in accordance with manufacturer's instructions in a manner requiring no disassembly prior to operation.
 - 2. The Contractor shall be solely responsible for the adequacy of the Preparation for Shipment provisions employed with respect to materials and application.
 - 3. One complete set of Installations, Operating and Maintenance Instructions shall be packed and shipped with the equipment. This set is in addition to the sets that are to be sent directly to the Owner.
- C. Handling: Avoid damage. Comply with manufacturer's installation instruction requirements for rigging, unloading and transporting units.
- D. Storage: Inside protected from weather, dirt and construction dust. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping. Cap all pipe ends. Taping pipe ends is not adequate or allowable.

1.08 PROJECT CONDITIONS

- A. General: Provide products which are compatible with other portions of the work and provide products with the proper power characteristics and similar adaptations for the project.
- B. Arrangement: Arrange ductwork and piping parallel with primary lines of the building construction and with a minimum 7 feet overhead clearance in unfinished equipment rooms where possible. Conceal all piping and ductwork where possible unless indicated otherwise. Locate operating and control equipment properly to provide easy access for operation and maintenance. Give right-of-way to piping which must be sloped for drainage. Set all equipment level or as recommended by manufacturer.
- C. Coordination: Where several elements of the work must be sequenced and positioned in order to fit the available space, prepare shop drawings showing the actual physical dimensions (at accurate scale) required for installation and submit prior to purchase/fabrication/installation of any of the elements involved in the coordination.

1.09 STANDARDS

- A. General: Provide all new materials and equipment, identical to apparatus or equipment in successful operation for a minimum of five years. Provide materials of comparable quality omitted here but necessary to complete the work. Maximum allowable variation from stated capacities, minus 5% to plus 10% as approved in each case.
- B. Governing Standards: The following are typical standards generally referenced in these specifications and identified by their acronym. Federal Specifications (FS), American Society for Testing Materials (ASTM), American National Standards Institute (ANSI), Manufacturer's Standardization Society of the Valve and Fitting Industry, Standard Practice (MSS SP-69), Cast Iron Soil Pipe Institute (CISPI), Underwriters Laboratory (UL) numbers are given.

1.10 WARRANTIES

- A. Refer to Section 01 78 00 - Closeout Submittals for further requirements.
- B. Provide five year warranty on all refrigeration compressors.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 LAYOUT AND COORDINATION

- A. Site Examination: Before starting work, carefully examine site and all Contract Drawings. Become thoroughly familiar with conditions governing work on this project. Verify all indicated elevations, building measurements, rough-in dimensions and equipment locations before proceeding with any work.
- B. Utility Locations: The location of all utilities, wires, conduits, pipes, ducts, or other service facilities are shown in a general way only on the drawings and in some instances are taken from existing drawings. Ascertain whether any additional facilities other than those shown on the plans may be present and determine the exact location and elevations of all utilities prior to commencing installation.
- C. Discrepancies: Any error, conflict or discrepancy in Drawings, Specifications and/or existing conditions shall be reported immediately. Do not proceed with any questionable items of work until clarification of same has been made. Should rearrangement or re-routing of piping or ductwork be necessary, provide for approval the simplest layout possible for that particular portion of the work. Under no circumstances shall beams, girders, footings or columns be cut for mechanical items. Casting of pipes into concrete is prohibited unless so shown on Drawings.
- D. The Contractor shall cooperate with others to avoid interferences and delays in the construction work.
- E. Interference as a result of poor coordination or lack of cooperation with other trades shall be corrected at the Contractor's expense.

3.02 CONTINUITY OF EXISTING SERVICES

- A. Existing water, power, heat, ventilation, air conditioning and other services shall remain in service during new construction work. Coordinate any interruption in service during new construction work. Coordinate any interruption of these services with the Owner's representative a minimum of twenty-four (24) hours in advance.
- B. Protect from damage active utilities existing and evident by reasonable inspection of the site whether shown or not on the Drawings. Protect, relocate or abandon utilities encountered in the work which were not shown on the Drawings or evident by inspection of the work as directed by the Architect. Maintain continuity of all utility services to existing buildings.

3.03 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1.
- B. Protection: During cutting and patching, protect adjacent installations. Provide temporary barriers to prevent the spread of dust and dirt outside of the immediate work area.

- C. Repair: Patch finished surfaces and building components using new materials to match the existing.
- D. Inspection: Upon written direction from the Architect, uncover and restore work to provide for observation of concealed work.

3.04 EQUIPMENT REMOVAL

- A. All removed equipment is the property of the Contractor unless indicated otherwise. Disconnect and remove all such equipment from the property. Cap all piping in walls, below floors, and/or above ceilings in finished rooms.
- B. Where equipment is to be reused, reconnect piping, wiring and/or controls to allow this equipment to function as it had prior to this renovation unless indicated otherwise.

3.05 MECHANICAL EQUIPMENT WIRING

- A. Provide all motor starters, control devices, and wiring complete from power source indicated on Drawings.
- B. Equipment and systems shown on the Drawings and/or specifications, are based upon requirements of specific manufacturers which are intended as somewhat typical of several makes which may be approved. Provide all field wiring and/or devices necessary for a complete and operable system controls for the actual selected equipment/system.

3.06 INSTALLATION

- A. Locating and Positioning Equipment: Observe all Codes and Regulations and good common practice in locating and installing mechanical equipment and material so that completed installation presents the least possible hazard. Maintain recommended clearances for repair and service to all equipment.
- B. Anchorage: Anchor and/or brace all mechanical equipment, piping and ductwork to resist displacement due to seismic action, include snubbers on equipment mounted on spring isolators.
- C. Where mounting heights or locations are not identified, install systems, equipment and materials to provide maximum headroom.
- D. Provide clearance for installation of insulation and access to valves, fittings, damper actuators, etc. on pipe and duct systems.
- E. Install systems, materials and equipment giving right of way to systems required to be installed at a specific slope or operation by gravity.
- F. Provide condensate drain piping to over nearest floor drain for all coils, furnaces, boilers, domestic water heaters and the likes.
- G. Provide all sheaves required for final air balance. Contractor shall not make assumptions or exceptions concerning the number of sheave replacements or adjustments necessary to meet the design requirements. Balance all HVAC systems to provide the amount of air indicated at each diffuser, grille or register.
- H. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and the fan has been test run under observation. Fans shall not be used during construction unless specifically authorized by the Owner and reviewed by the Engineer.
- I. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
- J. Installation shall be in accordance with the requirements of the equipment manufacturer, including special requirements for seismic restraints.
- K. Equipment Manufacturer's Responsibility and Services:
 - 1. A manufacturer's representative for major equipment and operating systems shall be provided as necessary to assist the Contractor during installation, and to provide written certification that the equipment has been installed as specified and in accordance with the manufacturer's representative.

2. The manufacturer's representative shall provide the initial startup of equipment in the presence of the Owner.
 - a. Provide a pre-start check of all piping, valves, control devices, control panels, and equipment.
 - b. Calibrate and adjust equipment and controls for operation at the specified design and conditions.
 - c. Provide a record of all startup events noting problems and their resolution.
 - d. Provide a record of all set points for operational controls and devices.
3. Upon the completion of the equipment startup, provide instructional time with the Owner's personnel to review the operations and maintenance manuals and perform each step necessary for startup, shutdown, troubleshooting, and routine maintenance. The instructional time shall be scheduled through the Owner.
4. Upon completion of the inspections, startup, testing, and checkout procedures, the equipment manufacturer shall submit written notice to the Owner that the units are ready for use by the Owner. Provide a certificate of calibration for all equipment.

3.07 MOUNTING AND SHIMMING

- A. Mount equipment as shown on the Drawings. Provisions for mounting special equipment on spring isolators, snubbers, and inertia bases are specified in Section 23 05 48, Vibration Isolation and Sound and Seismic Controls for HVAC Piping and Equipment.
- B. Level the equipment by means of 304 stainless steel wedges (stainless steel plates and stainless steel shims). Wedge taper shall not be greater than 1/4 inch per foot. Use double wedges to provide a level bearing surface for the equipment. Secure each pair of wedges in their final positions with one tack weld on each side after leveling is complete. Wedging shall be executed in a manner that will prevent a change in level or springing of the Baseplate when the anchor bolts are tightened.
 1. Adjust rotating equipment assemblies such that the driving units are properly aligned, plumb and level with the driven units and all interconnecting shafts and couplings.
 2. All rotating equipment shall be checked for proper alignment with dial indicators or laser after completion of grouting. The alignment must be within the tolerances required by the equipment manufacturer. The final alignment check shall be witnessed by the Owner.

3.08 INSPECTION

- A. The Contractor shall inspect his work to ensure the installation and workmanship is in accordance with these specifications and acceptable industry standards for the work being done.
- B. All materials, equipment, and workmanship shall be subject to inspection at any time by the Owner. Contractor shall correct any work, materials, or equipment not in accordance with the Contract Documents.

3.09 SAFETY CONSIDERATIONS

- A. All equipment shall be installed with suitable access clearances that satisfy OSHA and code requirements for maintenance or removal of replaceable parts and components, and with necessary unions or flanges to perform the maintenance or removal without removing the connecting appurtenances.
- B. Where equipment requiring periodic maintenance cannot be reached by normal walkways because of interference with ductwork, piping, or other obstructions the Contractor shall notify the Owner and propose an alternate safe means of access. These may include construction of an overhead platform with stairway or ladder ends and safety railings or handholds, or walk-through duct plenums with hinged access doors, or as required to meet OSHA standards for safe maintenance procedures.

3.10 CLEANING, START-UP, AND ADJUSTING

- A. The Contractors shall be responsible for proper operation of all systems, minor subsystems, and services provided under this section. He shall coordinate start-up procedures, calibration, and system checkout with all project managers. Any system operational problems shall be

diagnosed; all correctional procedures shall be initiated as required to bring out the system into compliance with the design, and the problem then shall be rechecked to verify that the system operates normally.

- B. Thoroughly clean all parts of the installation at the completion of the work. The Contractor shall clean up and remove from the premises all refuse material, crates, and rubbish arising from his work. Remove, clean, and reinstall all filters. Belt-drive tensions and alignments shall be checked. All motors and bearings shall be lubricated in accordance with the manufacturer's service manuals prior to equipment start-up. Provide a lubrication schedule for every item of equipment furnished under this section. The schedule shall include the type of lubricant and the application frequency.

END OF SECTION 23 00 00

SECTION 23 05 13**COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Single phase electric motors.
- B. Three phase electric motors.

1.02 RELATED REQUIREMENTS

- A. Division 26 - Electrical.

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 1/2 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 and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- B. Conform to NFPA 70.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. 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 Procedures, for additional warranty requirements.
- B. Provide five year manufacturer warranty for motors larger than 20 horsepower.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. G.E. Model ECM.
- B. Reliance Electric/Rockwell Automation; Model E-Master: www.reliance.com.

- C. Baldor Model; Super-E: www.baldor.com.
- D. Marathon Model XRI.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service: Refer to Section 26 for required electrical characteristics.
- B. Nominal Efficiency:
- C. Construction:
 1. Open drip-proof type except where specifically noted otherwise.
 2. Design for continuous operation in 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.
- D. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.
- E. 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.
- F. 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 conform to these specifications.
- B. Single phase motors for shaft mounted fans, oil burners, 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, pumps, blowers, and air compressors: Capacitor start type.
- E. Single phase motors for fans, blowers, and pumps: Capacitor start, capacitor run type.
- F. Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.
- G. Motors located in outdoors, in wet air streams downstream of sprayed coil dehumidifiers, in draw through cooling towers, and in humidifiers: Totally enclosed weatherproof epoxy-treated type.
- H. Motors located outdoors and in draw through cooling towers: Totally enclosed weatherproof epoxy-sealed type.

2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.05 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.

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- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.06 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.07 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
- E. Insulation System: NEMA Class B or better.
- F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 26 29 13.
- I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- J. Sound Power Levels: To NEMA MG 1.
- K. Part Winding Start Above 254T Frame Size: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
- L. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure or coat windings with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
- M. Nominal Efficiency: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.
- N. Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

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.

3.02 SCHEDULE

- A. NEMA Open Motor Service Factors.
 - 1. 1/6-1/3 hp:
 - a. 3600 rpm: 1.35.
 - b. 1800 rpm: 1.35.
 - c. 1200 rpm: 1.35.
 - d. 900 rpm: 1.35.
 - 2. 1/2 hp:
 - a. 3600 rpm: 1.25.
 - b. 1800 rpm: 1.25.
 - c. 1200 rpm: 1.25.
 - d. 900 rpm: 1.15.
 - 3. 3/4 hp:
 - a. 3600 rpm: 1.25.
 - b. 1800 rpm: 1.25.
 - c. 1200 rpm: 1.15.
 - d. 900 rpm: 1.15.
 - 4. 1 hp:
 - a. 3600 rpm: 1.25.
 - b. 1800 rpm: 1.15.
 - c. 1200 rpm: 1.15.
 - d. 900 rpm: 1.15.
 - 5. 1.5-150 hp:
 - a. 3600 rpm: 1.15.
 - b. 1800 rpm: 1.15.
 - c. 1200 rpm: 1.15.
 - d. 900 rpm: 1.15.
- B. Minimum Motor Efficiencies:
 - 1. Conform with applicable State Energy Code.

END OF SECTION 23 05 13

SECTION 23 05 48**VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Equipment support bases.
- B. Vibration isolators.
- C. Seismic snubber assemblies.
- D. Seismic restraints for suspended components and equipment..
- E. Roof curbs.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 49 - HVAC Seismic Restraint.

1.03 REFERENCE STANDARDS

- A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; 2015.
- B. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2002.
- C. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- D. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- E. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2011.
- F. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; Sheet Metal and Air Conditioning Contractors' National Association; 2008.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data:
 - 1. Provide manufacturer's product literature documenting compliance with PART 2 PRODUCTS.
 - 2. Include seismic rating documentation for each isolator and restraint component accounting for horizontal, vertical, and combined loads.
- C. Shop Drawings:
 - 1. Provide schedule of vibration isolator type with location and load on each.
 - 2. Fully dimensioned fabrication drawings and installation details for vibration isolation bases, member sizes, attachments to isolators, and supported equipment.
 - 3. Include auxiliary motor slide bases and rails, base weights, inertia bases, concrete weights, equipment static loads, support points, vibration isolators, and detailed layout of isolator location and orientation with static and dynamic load on each isolator.
 - 4. Include selections from prescriptive design tables that indicate compliance with the applicable building code and the vibration isolator manufacturer's requirements.
 - 5. Clearly indicate the load and capacity assumptions selected. Include copies of any calculations.
 - 6. Include the calculations that indicate compliance with the applicable building code for seismic controls and the vibration isolator manufacturer's requirements.
 - 7. Include the seal of the Professional Structural Engineer registered in the State of Oregon in which the Project is located, on the drawings and calculations which at a minimum include the following:
 - a. Seismic Restraint Details: Detailed drawings of seismic restraints and snubbers including anchorage details that indicate quantity, diameter, and depth of penetration, edge distance, and spacing of anchors.
 - b. Equipment Seismic Qualification Certification: Certification by the manufacturer or responsible party that each piece of equipment provided will withstand seismic force levels as specified in the applicable building code for seismic controls.

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

- 1) Basis for Certification: Indicate whether the withstand certification is based on actual testing of assembled components, on calculations, or on historic data.
 - 2) Indicate equipment to be sufficiently durable to resist design forces and or remain functional after the seismic event.
 - c. Dimensioned outline drawings of equipment identifying center of gravity, locations, and provisions for mounting and anchorage.
 - d. Detailed description of the equipment anchorage devices on which the certifications are based.
- D. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

1.05 QUALITY ASSURANCE

- A. Perform design and installation in accordance with applicable codes.
- B. Designer Qualifications: Perform design under direct supervision of a Professional Structural Engineer experienced in design of this type of work and registered and licensed in Oregon.
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
 1. Member of Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years of documented experience.
- E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Kinetics Noise Control, Inc.: www.kineticsnoise.com.
- B. Mason Industries: www.mason-ind.com.
- C. M.W. Saussé & Co., Inc.; www.vibrex.net.
- D. Amber/Booth Company: www.amberbooth.com.
- E. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. General:
 1. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.
 2. Steel springs to function without undue stress or overloading.
 3. Steel springs to operate in the linear portion of the load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 4. Lateral to vertical stiffness ratio to not exceed 0.08 with spring deflection at minimum 75 percent of specified deflection.
 5. All equipment mounted on vibration isolated bases to have minimum operating clearance of 2 inches between the base and floor or support beneath unless noted otherwise.
- B. Provide vibration isolation on motor driven equipment over 2.0 hp, plus connected piping and ductwork.
- C. Provide minimum static deflection of isolators for equipment as follows:
 1. Basement, Under 20 hp
 - a. 400 - 600 rpm: 1 inch
 - b. 600 - 800 rpm: 0.5 inch
 - c. 800 - 900 rpm: 0.2 inch
 - d. 1100 - 1500 rpm: 0.14 inch
 - e. Over 1500 rpm: 0.1 inch
 2. Upper Floors, Normal

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- a. 400 - 600 rpm: 3.5 inch
- b. 600 - 800 rpm: 2 inch
- c. 800 - 900 rpm: 1 inch
- d. 1100 - 1500 rpm: 0.5 inch
- e. Over 1500 rpm: 0.2 inch
- 3. Upper Floors, Critical
 - a. 600 - 800 rpm: 3.5 inch
 - b. 800 - 900 rpm: 2 inch
 - c. 1100 - 1500 rpm: 1 inch
 - d. Over 1500 rpm: 0.5 inch
- D. Consider upper floor locations critical unless otherwise indicated.
- E. Maintain sound level of spaces at levels not to exceed those listed below by utilizing acoustical devices.
- F. Maintain rooms at following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE Handbook, HVAC Applications.
 - 1. Schools:
 - a. Lecture and classrooms: 25
 - b. Open-plan classrooms: 30

2.03 EQUIPMENT SUPPORT BASES

- A. Structural Bases:
 - 1. Construction: Engineered, structural steel frames with welded brackets for side mounting of the isolators.
 - 2. Frames: Square, rectangular or T-shaped.
 - 3. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
 - 4. Applications: Adjustable motor slide rails for centrifugal fans.
- B. Concrete Inertia Bases:
 - 1. Construction: Engineered, steel forms, with integrated isolator brackets and anchor bolts, welded or tied reinforcing bars running both ways in a single layer.
 - 2. Size: 6 inches minimum depth and sized to accommodate elbow supports.
 - 3. Mass: Minimum of 1.5 times weight of isolated equipment.
 - 4. Connecting Point: Reinforced to connect isolators and snubbers to base including template and fastening devices for equipment.
 - 5. Concrete: Filled on site with minimum 3000 psi concrete.
 - 6. Applications: Adjustable motor slide rails for centrifugal fans.

2.04 VIBRATION ISOLATORS

- A. Non-Seismic Type:
 - 1. All Elastomeric-Fiber Glass Pads:
 - a. Configuration: Flat or molded.
 - b. Thickness: 0.25 inch minimum.
 - c. Assembly: Single or multiple layers using bonded, galvanized sheet metal separation plate between each layer with load plate providing evenly distributed load over pad surface.
 - 2. Elastomeric Mounts:
 - a. Material: Oil, ozone, and oxidant resistant compounds.
 - b. Assembly: Encapsulated load transfer plate bolted to equipment and base plate with anchor hole bolted to supporting structure.
 - 3. Steel Springs:
 - a. Assembly: Freestanding, laterally stable without housing.
 - b. Leveling Device: Rigidly connected to equipment or frame.
 - 4. Restrained Steel Springs:

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- a. Housing: Rigid blocking during rigging prevents equipment installed and operating height from changing during temporary weight reduction.
- b. Equipment Wind Loading: Adequate means for fastening isolator top to equipment and isolator base plate to supporting structure.
- 5. Elastomeric Hangers:
 - a. Housing: Steel construction containing elastomeric isolation element to prevent rod contact with housing and short-circuiting of isolating function.
 - b. Furnish steel load distribution plate sandwiching elastomeric element to housing.
- 6. Spring Hanger:
 - a. Housing: Steel construction containing stable steel spring and integral elastomeric element preventing metal to metal contact.
 - b. Bottom Opening: Sized to allow plus/minus 15 degrees rod misalignment.
- 7. Combination Elastomeric-Spring Hanger:
 - a. Housing: Steel construction containing stable steel spring with elastomeric element in series isolating upper connection of hanger box to building structure.
 - b. Bottom Opening: Sized to allow plus/minus 15 degrees rod misalignment.
- 8. Thrust Restraints:
 - a. Housing: Steel construction containing stable steel spring and integral elastomeric element installed in pairs to resist air pressure thrusts.
 - b. Bottom Openings: Sized to allow plus/minus 15 degrees rod misalignment.
- B. Seismic Type:
 - 1. Coil Springs Consisting of Multiple Elements:
 - a. Housing: Manufactured from cast iron, cast aluminum, or steel material.
 - b. Ductile Material: Designed and rated for seismic applications.
 - c. Spring: Restrained by housing without significant degradation of vibration isolation capabilities during normal equipment operating conditions.
 - d. Resilient Snubbing Grommet System: Incorporated and designed with clearances of no more than 0.25 inch in any direction preventing direct metal-to-metal contact between supported member and fixed restraint housing.
 - e. Resilient Pad: Located in series with spring.
 - f. Coil Springs: Color coded elements to have a lateral stiffness greater than 0.8 times the rated vertical stiffness with 50 percent overload capacity.
 - g. Finish: Suitable for the application.
 - 2. All Directional Elastomeric:
 - a. Material: Molded from oil, ozone, and oxidant resistant compounds.
 - b. Operating Parameters: Designed to operate within the isolator strain limits providing maximum performance and service life.
 - c. Attachment Method: Encapsulated load transfer plate bolted to equipment and base plate with anchor hole bolted to supporting structure.
 - d. Rating: Cast iron and aluminum housings rated for seismic restraint applications.
 - e. Minimum Operating Static Deflections: Deflections indicated in project documents are not to exceed published load capacities.

2.05 SEISMIC SNUBBER ASSEMBLIES

- A. Comply with:
 - 1. ASHRAE Handbook - HVAC Applications
 - 2. FEMA 412
 - 3. FEMA 413
 - 4. FEMA 414
 - 5. FEMA E-74
 - 6. SMACNA - Seismic Duct Restraint Manual
- B. All Directional External:
 - 1. Application: Minimum three (3) snubbers are required for each equipment installation, oriented properly to restrain isolated equipment in all directions.

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2. Construction: Interlocking steel construction attached to the building structure and equipment in a manner consistent with anticipated design loads.
 3. Performance: Equipment movement at each snubber location limited to a maximum of 0.25 inches in any direction without significantly degrading the vibration isolation capability of the isolator during normal operating conditions.
 4. Resilient Pad: Minimum 0.25 inch thick cushions any impact and prevents metal-to-metal contact.
- C. Lateral External:
1. Application: Minimum three (3) snubbers are required for each stable equipment installation, oriented properly to restrain isolated equipment in all lateral directions where uplift forces are zero or addressed by other restraints.
 2. Construction: Steel construction attached to the building structure and equipment in a manner consistent with anticipated design loads.
 3. Performance: Equipment movement at each snubber location limited to a maximum of 0.25 inches in any direction without significantly degrading the vibration isolation capability of the isolator during normal operating conditions.
 4. Resilient Pad: Minimum 0.25 inch thick cushions any impact and prevents metal-to-metal contact.
- D. Omni Directional External:
1. Application: Minimum four (4) snubbers are required for each stable equipment installation, oriented properly to restrain isolated equipment in all lateral directions.
 2. Construction: Steel construction attached to the building structure and equipment in a manner consistent with anticipated design loads.
 3. Performance: Equipment movement at each snubber location limited to a maximum of 0.25 inches in any direction without significantly degrading the vibration isolation capability of the isolator during normal operating conditions.
 4. Resilient Pad: Minimum 0.25 inch thick cushions any impact and prevents metal-to-metal contact.
- E. Horizontal Single Axis External:
1. Application: Minimum four (4) snubbers are required for each stable equipment installation, oriented properly to restrain isolated equipment in all lateral directions where uplift forces are zero or addressed by other restraints.
 2. Construction: Steel construction attached to the building structure and equipment in a manner consistent with anticipated design loads.
 3. Performance: Equipment movement at each snubber location limited to a maximum of 0.25 inches in any direction without significantly degrading the vibration isolation capability of the isolator during normal operating conditions.
 4. Resilient Pad: Minimum 0.25 inch thick cushions any impact and prevents metal-to-metal contact.

2.06 SEISMIC RESTRAINTS FOR SUSPENDED COMPONENTS AND EQUIPMENT

- A. Comply with:
1. ASHRAE Handbook - HVAC Applications
 2. FEMA 412
 3. FEMA 413
 4. FEMA 414
 5. FEMA E-74
 6. SMACNA - Seismic Duct Restraint Manual
- B. Cable Restraints:
1. Wire Rope: Steel wire strand cables sized to resist seismic loads in all lateral directions.
 2. Protective Thimbles: Eliminates potential for dynamic cable wear and strand breakage.
 3. Size: Based on the lesser of cable capacity or anchor load taking into account bracket geometry.
 4. Connections:

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- a. Use overlapping wire rope U clips, cable clamping bolts, swaged sleeves or seismically rated tool-less wedge insert lock connectors.
- b. Internally brace clevis hanger bracket cross bolt to prevent deformation.
- 5. Vertical Suspension Rods: Attach required bracing of sufficient strength to prevent rod buckling from vertical compression forces utilizing series of attachment clips.
- C. Rigid Restraints:
 - 1. Structural Element: Sized to resist seismic loads in all lateral directions and carry both compressive and tensile loading.
 - 2. Size: Based on the lesser of cable capacity or anchor load taking into account bracket geometry.
 - 3. Connections: Internally brace clevis hanger bracket cross bolt to prevent deformation.
 - 4. Static Support System: Anchorage capable of carrying additional tension loads generated by the vertical component of the rigid brace compression which is additive to any static load requirements on the system.
 - 5. Vertical Suspension Rods: Attached required bracing of sufficient strength to prevent rod buckling from vertical compression forces utilizing series of attachment clips.

2.07 ROOF CURBS

- A. See Section 23 55 33 - Fuel-Fired Unit Heaters.

PART 3 EXECUTION**3.01 INSTALLATION - GENERAL**

- A. Install in accordance with manufacturer's instructions.
- B. Bases:
 - 1. Set steel bases for one inch clearance between housekeeping pad and base.
 - 2. Set concrete inertia bases for 2 inches clearance between housekeeping pad and base.
 - 3. Adjust equipment level.
- C. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- D. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- E. Provide pairs of horizontal limit springs on fans with more than 6.0 inches WC static pressure, and on hanger supported, horizontally mounted axial fans.
- F. Support piping connections to equipment mounted on isolators using isolators or resilient hangers as follows:
 - 1. Up to 4 Inches Pipe Size: First three points of support.
 - 2. 5 to 8 Inches Pipe Size: First four points of support.
 - 3. 10 inches Pipe Size and Over: First six points of support.
 - 4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.02 INSTALLATION - SEISMIC

- A. Refer to Section 23 0549.

3.03 FIELD QUALITY CONTROL

- A. Inspect isolated equipment after installation and submit report. Include static deflections.

3.04 SCHEDULE

- A. Pipe Isolation Schedule.
 - 1. 3/4 inch and 1 Inch Pipe Size: Isolate 120 diameters from equipment.

END OF SECTION 23 05 48

SECTION 23 05 49
HVAC SEISMIC RESTRAINT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Seismic restraint of equipment, piping and ductwork.

1.02 RELATED SECTIONS

- A. Section 23 00 00 - Basic HVAC Requirements.
- B. Section 23 05 48 - Vibration Isolation and Sound and Seismic Controls for HVAC Piping and Equipment.
- C. Section 23 07 19 - HVAC Piping Insulation.
- D. Section 23 31 00 - HVAC Ducts and Casings.
- E. Section 23 55 33 - Fuel-Fired Unit Heaters.
- F. Section 23 81 27 - Split-System Heating and Cooling.

1.03 QUALITY ASSURANCE

- A. Seismic Restraints:
 - 1. The Anchorage and/or seismic restraint of permanent equipment and associated systems listed below shall be designed to resist the total design seismic forces prescribed in the latest edition of the International Building Code.
 - a. All floor or roof-mounted equipment weighing 400 lbs. or greater.
 - b. All suspended or wall-mounted equipment weighing 20 lbs. or greater.
 - c. All vibration-isolated equipment weighing 20 lbs. or greater.
 - d. All piping 1 1/4 inches nominal diameter and larger located in boiler, mechanical equipment and refrigeration mechanical rooms.
 - e. All piping 2 1/2" inches nominal diameter and larger.
 - f. All ductwork 6 square feet and larger in cross sectional area.
 - g. All round ductwork 28 inches in diameter and larger.
 - h. Pipes, electrical conduit and ducts supported by a trapeze where none of those elements would individually require bracing, require bracing when the combined operating weight of all elements supported by the trapeze is 10 lbs/ft or greater.
 - B. All calculations shall be in accordance with Chapter 16 of the latest edition of the International Building Code.

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01 30 00:
 - 1. All anchorage and seismic restraints shall be designed and stamped by a professional engineer licensed in the state of the project location. Design shall include:
 - a. Number, size and location of anchors for floor or roof-mounted equipment. For curb-mounted equipment, provide design of attachment of both the unit to the curb and the curb to the structure. In addition, provide calculations or test data verifying the curb can accept the seismic loads.
 - b. Number, size and location of seismic restraint devices and anchors for vibration-isolated and suspended equipment. Provide calculations or test data verifying the horizontal and vertical ratings of the seismic restraint devices.
 - c. Number, size and location of braces and anchors for suspended piping and ductwork on shop drawings. In addition:
 - 1) The contractor must select a single seismic restraint system pre-designed to meet the requirements of the latest edition of the International Building Code such as the 2011 Mason Industries Seismic Restraint Guidelines for Suspended Piping, Ductwork, Electrical Systems and floor and roof mounted equipment.

- 2) Details or designs from separate seismic restraint guidelines are not acceptable. Installations not addressed by the selected system must be designed, detailed and submitted along with the shop drawings.
- 3) Maximum seismic loads shall be indicated on drawings at each brace location. Drawings shall bear the stamp and signature of the registered professional engineer licensed in the state of the project location who designed the layout of the braces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Amber Booth.
- B. Mason Industries, Inc.
- C. Kinetics Corporation.
- D. Vibrex.
- E. Substitutions: Under provisions of Section 01 60 00.

2.02 SEISMIC RESTRAINTS

- A. General Requirements:
 1. Seismic restraints shall be provided for all equipment, both supported and suspended, piping and ductwork as listed above.
 2. Bracing of piping and ductwork shall be in accordance with provisions set forth in SMACNA seismic restraint manual.
 3. Structural requirements for restraints, including their attachment to building structure, shall be reviewed and approved by the structural engineer.
 4. Attachments to supported or suspended equipment must be coordinated with the equipment manufacturer.
- B. Supported Equipment Products:
 1. Seismic restraints shall consist of interlocking steel members restrained by shock absorbed neoprene materials compounded to bridge bearing specifications as previously noted in paragraph 1.3. Elastomeric materials shall be replaceable and be a minimum 3/4-inch thick. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8-inch, nor more than 1/4-inch. Type 1 - Seismic Snubbers: All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of 1/4 inch thick. A minimum air gap of 1/8 inch shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. The snubber shall be designed to accept horizontal and vertical seismic loads as defined in Section 1.03.B. Mason Type Z-1225 or Z-1011.
 2. Each snubber shall be capable of restraint in all three mutually orthogonal directions. Type 2 - Seismic Sway Braces - Seismic sway braces shall consist of galvanized steel aircraft cables or steel angles/channels. Cables braces shall be designed to resist seismic tension loads and steel braces shall be designed to resist both tension and compression loads with a minimum safety factor of 2. Brace end connections shall be steel assemblies that swivel to the final installation angle. Do not mix cable and steel braces to brace the same system or equipment. Steel angles, when required, shall be clamped to the threaded hanger rods at the seismic sway brace locations utilizing a minimum of two ductile iron clamps. Sway braces shall be designed to accept horizontal and vertical seismic loads as defined in Section 1.03.B. Mason Type SCB, SSB, SRC and UC.
 3. Submittals shall include load versus deflection curves up to 1/2-inch on the x, y and z planes.
 4. Mason Model Z-1011
- C. Bracing of Pipes:

1. Provide seismic bracing of all piping as detailed below. (Exception: Piping suspended by individual hangers 12 inches or less in length, as measured from the top of the pipe to the bottom of the support where the hanger is attached, need not be braced).
 - a. Brace all gas piping.
 - b. Brace all piping located in boiler rooms, mechanical equipment rooms, and refrigeration mechanical rooms that is 1-1/4-inch nominal diameter and larger.
 - c. Brace all pipes 2-1/2-inch nominal diameter and larger.
 2. For all gas piping, as specified in 1(a) the bracing details, schedules, and notes may be used, except that transverse bracing shall be at 20 feet maximum, and longitudinal bracing shall be at 40 feet maximum.
 3. Seismic braces for pipes on trapeze hangers may be used.
 4. Provide flexibility in joints where pipes pass through building seismic joints or expansion joints or where rigidly supported pipes connect to equipment with vibration isolators. For threaded piping, the flexibility may be provided by the installation of swing joints.
 5. Cast iron pipe of all types, glass pipe, and any other pipe jointed with a shield and clamp assembly, where the top of the pipe is 12 inches or more from the supporting structure, shall be braced on each side of a change in direction of 90 degrees or more. Riser joints shall be braced or stabilized between floors.
 6. Vertical risers shall be laterally supported with a riser clamp at each floor. For buildings greater than six stories high, all risers shall be engineered individually.
- D. Bracing of Ductwork:
1. Brace rectangular ducts with cross sectional areas of 6 square feet and larger. Brace flat oval ducts in the same manner as rectangular ducts. Brace round ducts with diameters of 28 inches and larger. Brace flat oval ducts the same as rectangular ducts of the same nominal size (Exception: No bracing is required if the duct is suspended by hangers 12 inches or less in length, as measured from the top of the duct to the bottom of the support where the hanger is attached).
 2. Transverse bracing shall occur at the interval specified in the SMACNA tables or at both ends if the duct run is less than the specified interval. Transverse bracing shall be installed at each duct turn and at each end of a duct run, with a minimum of one brace at each end.
 3. Longitudinal bracing shall occur at the interval specified in the SMACNA tables with at least one brace per duct run. Transverse bracing for one duct section may also act as longitudinal bracing for a duct section connected perpendicular to it if the bracing is installed within four feet of the intersection of the ducts and if the bracing is sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.
- E. Suspended Equipment and Piping and Ductwork:
1. Cable Method: The seismic restraint shall consist of a combination of stranded steel aircraft cable and the specified vibration isolation hanger with an added nut and neoprene and steel washer. The cable resists lateral and downward motion. The modified vibration hanger resists upward motion.
 2. Cable attachment details, cable size, and the neoprene and steel washers shall be sized by the manufacturer and are to be indicated in the Shop Drawings.
 3. Provide detailed Shop Drawings for approval in sufficient time to allow structural attachment work to be incorporated into the normal work sequence.

PART 3 EXECUTION

3.01 SEISMIC RESTRAINTS

- A. General:
1. Install and adjust seismic restraints so that the equipment, piping, and ductwork supports are not degraded by the restraints.
 2. Restraints must not short circuit vibration isolation systems or transmit objectionable vibration or noise.
- B. Supported Equipment:

1. Each vibration isolation frame for supported equipment shall have a minimum of four seismic snubbers mounted as close as possible to the vibration isolators and/or the frame extremities.
 2. Care must be taken so that a minimum 1/8-inch air gap in the seismic restraint snubber is preserved on all sides in order that the vibration isolation potential of the isolator is not compromised. This requires that the final snubber adjustment be completed after the vibration isolators are properly installed and the installation approved.
- C. Bracing of Pipes:
1. Branch lines may not be used to brace main lines.
 2. Transverse bracing shall be at 40 feet maximum except where a lesser spacing is indicated in the SMACNA tables for bracing of pipes.
 3. Longitudinal bracing shall be at 80 feet maximum except where a lesser spacing is indicated in the tables. In pipes where thermal expansion is a consideration, an anchor point may be used as the specified longitudinal brace provided that it has a capacity equal to or greater than a longitudinal brace. The longitudinal braces and connections must be capable of resisting the additional force induced by expansion and contraction.
 4. A rigid piping system shall not be braced to dissimilar parts of the building or to two dissimilar building systems that may respond differently during an earthquake.
 5. Transverse bracing for one pipe section may also act as longitudinal bracing for a pipe section of the same size connected perpendicular to it if the bracing is installed within 24 inches of the elbow or tee.
- D. Bracing of Ductwork:
1. Hangers must be positively attached to the duct within 2 inches of the top of the duct with a minimum of two #10 sheet metal screws.
 2. Group of ducts may be combined in larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
 3. Walls, including gypsum board nonbearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide solid blocking around duct penetrations at stud wall construction.
 4. Unbraced ducts shall be installed with a 6-inch minimum clearance to vertical ceiling hanger wires.
- E. Suspended Equipment, Piping, and Ductwork Cable Method:
1. Cables shall be adjusted to a degree of slackness approved by the Structural Engineer.
 2. Uplift and downward restraint nuts and washers for the Type HST hangers shall be adjusted so that there is a minimum 1/4-inch clearance.

END OF SECTION 23 05 49

SECTION 23 05 53**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Pipe Markers.
- D. Labels.
- E. Lockout devices.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2016.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Brady Corporation: www.bradycorp.com.
- B. Safety Sign Company: www.safetysignco.com.
- C. Seton Identification Products: www.seton.com/aec.
- D. Substitutions: Not permitted.

2.02 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: Black.
 - 2. Letter Height: 1/2 inch.
 - 3. Background Color: Yellow.
 - 4. Plastic: Conform to ASTM D709.

2.03 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 PIPE MARKERS

- A. Color: Conform to ASME A13.1.

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- B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.05 LABELS

- A. Description: Aluminum, size 1.9 x 0.75 inches, adhesive backed with printed identification.

2.06 LOCKOUT DEVICES

- A. Lockout Hasps:
 - 1. Manufacturers:
 - a. Anodized aluminum or Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.
- B. Valve Lockout Devices:
 - 1. Steel device preventing access to valve operator, accepting lock shackle.

PART 3 EXECUTION**3.01 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with 8 x 4 inch plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Tag automatic controls, instruments, and relays. Key to control schematic.
- I. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet 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.
- J. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION 23 05 53

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Measurement of final operating condition of HVAC systems.
- C. Sound measurement of equipment operating conditions.
- D. Vibration measurement of equipment operating conditions.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Cash Allowance: See Section 01 21 00 for additional requirements.
- B. Allowance includes testing, adjusting, and balancing of mechanical systems.

1.03 REFERENCE STANDARDS

- A. AABC MN-1 - AABC National Standards for Total System Balance; 2002.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit to Architect.
 - 2. Submit three weeks prior to starting the testing, adjusting, and balancing work.
 - 3. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
 - 4. Include at least the following in the plan:
 - a. Preface: An explanation of the intended use of the control system.
 - b. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - d. Identification and types of measurement instruments to be used and their most recent calibration date.
 - e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - f. Final test report forms to be used.
 - g. Detailed step-by-step procedures for TAB work for each system and issue, including:
 - 1) Terminal flow calibration (for each terminal type).
 - 2) Diffuser proportioning.
 - 3) Branch/submain proportioning.
 - 4) Total flow calculations.
 - 5) Rechecking.
 - 6) Diversity issues.
 - h. Expected problems and solutions, etc.
 - i. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
 - j. Details of how TOTAL flow will be determined; for example:

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- 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - k. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
 - l. Confirmation of understanding of the outside air ventilation criteria under all conditions.
 - m. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
 - n. Method of checking building static and exhaust fan and/or relief damper capacity.
 - o. Proposed selection points for sound measurements and sound measurement methods.
 - p. Methods for making coil or other system plant capacity measurements, if specified.
 - q. Time schedule for TAB work to be done in phases (by floor, etc.).
 - r. Description of TAB work for areas to be built out later, if any.
 - s. Time schedule for deferred or seasonal TAB work, if specified.
 - t. False loading of systems to complete TAB work, if specified.
 - u. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - v. Interstitial cavity differential pressure measurements and calculations, if specified.
 - w. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - x. Procedures for formal progress reports, including scope and frequency.
 - y. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Field Logs: Submit at least once a week to Commissioning Authority and Construction Manager.
- E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- F. Progress Reports.
- G. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1. Submit to the Commissioning Authority, Construction Manager, and HVAC controls contractor within two weeks after completion of testing, adjusting, and balancing.
 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 4. Provide reports in 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
 5. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 6. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 7. Units of Measure: Report data in I-P (inch-pound) units only.
 8. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Project Architect.
 - g. Project Engineer.
 - h. Project Contractor.

- i. Project altitude.
 - j. Report date.
- H. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC MN-1, AABC National Standards for Total System Balance.
 - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.
- F. TAB Supervisor Qualifications: Professional Engineer licensed in Oregon.
- G. Pre-Qualified TAB Agencies:
 - 1. Northwest Engineering Service, Inc.
 - 2. Air Balancing Specialty.
 - 3. Pacific Air Coast Balancing.
 - 4. Neudorfer Engineers.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
 - 1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

- B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.
- C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.
 - 3. Contract interpretation requests.
 - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- H. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.03 inches positive static pressure near the building entries.

3.07 SCOPE

- A. Test, adjust, and balance the following:
 1. Air Handling Units
 2. Air Filters
 3. Air Inlets and Outlets

3.08 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
 1. Manufacturer
 2. Model/Frame
 3. HP/BHP
 4. Phase, voltage, amperage; nameplate, actual, no load
 5. RPM
 6. Service factor
 7. Starter size, rating, heater elements
 8. Sheave Make/Size/Bore
- B. V-Belt Drives:
 1. Identification/location
 2. Required driven RPM
 3. Driven sheave, diameter and RPM
 4. Belt, size and quantity
 5. Motor sheave diameter and RPM
 6. Center to center distance, maximum, minimum, and actual
- C. Air Moving Equipment:
 1. Location
 2. Manufacturer
 3. Model number
 4. Serial number
 5. Arrangement/Class/Discharge
 6. Air flow, specified and actual
 7. Return air flow, specified and actual
 8. Outside air flow, specified and actual
 9. Total static pressure (total external), specified and actual
 10. Inlet pressure
 11. Discharge pressure
 12. Sheave Make/Size/Bore
 13. Number of Belts/Make/Size
 14. Fan RPM
- D. Return Air/Outside Air:
 1. Identification/location
 2. Design air flow
 3. Actual air flow
 4. Design return air flow
 5. Actual return air flow
 6. Design outside air flow
 7. Actual outside air flow

8. Return air temperature
 9. Outside air temperature
 10. Required mixed air temperature
 11. Actual mixed air temperature
 12. Design outside/return air ratio
 13. Actual outside/return air ratio
- E. Duct Traverses:
1. System zone/branch
 2. Duct size
 3. Area
 4. Design velocity
 5. Design air flow
 6. Test velocity
 7. Test air flow
 8. Duct static pressure
 9. Air temperature
 10. Air correction factor
- F. Duct Leak Tests:
1. Description of ductwork under test
 2. Duct design operating pressure
 3. Duct design test static pressure
 4. Duct capacity, air flow
 5. Maximum allowable leakage duct capacity times leak factor
 6. Test apparatus
 - a. Blower
 - b. Orifice, tube size
 - c. Orifice size
 - d. Calibrated
 7. Test static pressure
 8. Test orifice differential pressure
 9. Leakage
- G. Air Distribution Tests:
1. Air terminal number
 2. Room number/location
 3. Terminal type
 4. Terminal size
 5. Area factor
 6. Design velocity
 7. Design air flow
 8. Test (final) velocity
 9. Test (final) air flow
 10. Percent of design air flow
- H. Sound Level Reports:
1. Location
 2. Octave bands - equipment off
 3. Octave bands - equipment on
- I. Vibration Tests:
1. Location of points:
 - a. Fan bearing, drive end
 - b. Fan bearing, opposite end
 - c. Motor bearing, center (if applicable)
 - d. Motor bearing, drive end

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- e. Motor bearing, opposite end
 - f. Casing (bottom or top)
 - g. Casing (side)
 - h. Duct after flexible connection (discharge)
 - i. Duct after flexible connection (suction)
- 2. Test readings:
 - a. Horizontal, velocity and displacement
 - b. Vertical, velocity and displacement
 - c. Axial, velocity and displacement
 - 3. Normally acceptable readings, velocity and acceleration
 - 4. Unusual conditions at time of test
 - 5. Vibration source (if non-complying)

END OF SECTION 23 05 93

SECTION 23 07 13
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Duct insulation.
- B. Duct Liner.
- C. Insulation jackets.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 09 90 00 - Painting and Coating: Painting insulation jackets.
- C. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- D. Section 23 31 00 - HVAC Ducts and Casings: Glass mineral wool ducts.

1.03 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.
- D. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.
- F. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2014.
- G. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2012.
- H. ASTM C 1338 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- J. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- K. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
- L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).
- M. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE).
- N. North American Insulation Manufacturers Association (NAIMA).
- O. National Fire Protection Association (NFPA).
- P. Underwriter's Laboratories (UL Environment).
- Q. Underwriter's Laboratories Environmental (UL Environment).

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.
- C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section.
- C. Surface-Burning Characteristics: For insulation and related materials, UL/ULC Classified per UL 723 or meeting ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
- D. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
- E. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- F. 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).
- G. 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.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled 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.

1.08 DEFINITIONS

- A. Thermal Conductivity (K value): Units of Btu-inch/hour per square foot per degree F.
- B. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no paper exposed.
- C. ASJ: All Service Jacket (no outer film).
- D. SSL+: Self-Sealing Lap with Advanced Closure System.
- E. SSL: Self-Sealing Lap.
- F. FSK: Foil Scrim Kraft; jacketing.
- G. PSK: Poly Scrim Kraft; jacketing.
- H. PVC: PolyVinyl Chloride.
- I. Glass Mineral Wool: Interchangeable with fiber glass, but replacing the term in the attempt to disassociate and differentiate Glass Mineral Wool from the potential health and safety of special purpose or reinforcement products that do not meet the bio solubility criteria of insulation made from glass. Rock Mineral Wool will replace the traditional Mineral Wool label. Both are used in lieu of the Mineral Mineral Wool label.
- J. UL GREENGUARD Gold Certification: (formerly known as GREENGUARD Children & Schools Certification) offers stricter certification criteria, considers safety factors to account for sensitive individuals (such as children and the elderly), and ensures that a product is acceptable for use

in environments such as schools and healthcare facilities. It is referenced by both The Collaborative for High Performance Schools (CHPS) and the Leadership in Energy Environmental Design (LEED) Building Rating Systems.

- K. Declare and The Living Building Challenge - The Living Building Challenge is a philosophy, advocacy tool and certification program that addresses development at all scales. The purpose of The Living Building Challenge is to define the most advanced measure of sustainability in the built environment today and acts to diminish the gap between current limits and ideal solutions. Declare supports The Living Building Challenge by providing a transparent materials database that project teams can select from to meet Imperative 11.
- L. Imperative 11, Red List - requires that manufacturers disclose the ingredients in their products to insure that they are free of Red List chemicals and materials. The Red List represents the "worst in class" materials, chemicals and elements known to pose serious risks to human health and the greater ecosystem.
- M. UL Classified: UL has tested and evaluated samples of the product with respect to certain properties of the product. UL Classifies products to:
 - 1. Applicable UL requirements.
 - 2. Standards for safety.
 - 3. Standards of other National and International organizations.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.

2.02 GLASS MINERAL WOOL, FLEXIBLE

- A. Manufacturer:
 - 1. Knauf Insulation; Atmosphere Duct Wrap with Ecosse Technology: www.knaufusa.com.
 - 2. Johns Manville: www.jm.com.
 - 3. Owens Corning Corporation: www.ocbuildingspec.com.
 - 4. CertainTeed Corporation: www.certainteed.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. 'K' value: 0.29 at 75 degrees F, when tested in accordance with ASTM C177.
 - 2. Maximum Service Temperature: 250 degrees F.
 - 3. Maximum Water Vapor Sorption: <5.0 percent by weight per ASTM C1104.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film (FSK).
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 3. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Outdoor Vapor Barrier Mastic:
 - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- F. Tie Wire: Annealed steel, 16 gage.

2.03 GLASS FIBER, RIGID

- A. Manufacturer:
 - 1. Knauf Insulation: www.knaufusa.com.
 - 2. Johns Manville Corporation: www.jm.com.
 - 3. CertainTeed Corporation; Model "ToughGard® Rigid Liner Board": www.certainteed.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Insulation: ASTM C612; rigid, noncombustible blanket.
 - 1. ASTM C1071, Type II.
 - 2. 'K' value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
 - 3. Maximum service temperature: 450 degrees F.
 - 4. Maximum Water Vapor Sorption: 5.0 percent.
 - 5. Maximum Density: 8.0 lb/cu ft.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 3. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Indoor Vapor Barrier Finish:
 - 1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
 - 2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- F. UL/ULC Classified per UL 723. Comply with ASTM C 1071 Type I and Type II, NFPA 90A, and NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard." UL GREENGUARD Certified does not support the growth of mold, fungi, or bacteria per ASTM C 1338 and meets UL Environment GREENGUARD Microbial Resistance Listing per UL 2824-"GREENGUARD Certification Program Method for Measuring Microbial Resistance ". UL/E validated to be formaldehyde free. DecaBDP Free.

2.04 GLASS MINERAL WOOL, RIGID

- A. Manufacturer:
 - 1. Knauf Insulation: www.knaufinsulation.com.
 - 2. Johns Manville: www.jm.com.
 - 3. Owens Corning Corp: www.owenscorning.com.
 - 4. CertainTeed Corporation; Model "ToughGard® Rigid Liner Board": www.certainteed.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
 - 1. ASTM C1071, Type II.
 - 2. 'K' value: 0.24 at 75 degrees F, when tested in accordance with ASTM C177.
 - 3. Maximum service temperature: 250 degrees F.
 - 4. Maximum Water Vapor Sorption: 5.0 percent.
 - 5. Maximum Density: 4.25 lb/cu ft.
- C. UL/ULC Classified per UL 723. Comply with ASTM C 1071 Type I and Type II, NFPA 90A, and NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard." UL GREENGUARD Certified does not support the growth of mold, fungi, or bacteria per ASTM C 1338 and meets UL Environment GREENGUARD Microbial Resistance Listing per UL 2824-"GREENGUARD Certification Program Method for Measuring Microbial Resistance ". UL/E validated to be formaldehyde free. DecaBDP Free.

2.05 INSULATION BOARD

- A. Manufacturer:
 - 1. Knauf Insulation: w/ECOSE Technology: www.knaufusa.com.
 - 2. Johns Manville Corporation: www.jm.com.
 - 3. Owens Corning Corp: www.owenscorning.com.
 - 4. CertainTeed Corporation: www.certainteed.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
 - 1. ASTM C795.

2. 'K' value: 0.24 at 75 degrees F, when tested in accordance with ASTM C177.
3. Maximum service temperature: 250 degrees F.
4. Maximum Water Vapor Sorption: 5.0 percent.
5. Maximum Density: 4.25 lb/cu ft.

2.06 JACKETS

- A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
 1. Lagging Adhesive:
 - a. Compatible with insulation.
- B. Glass Mineral Wool (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square.
- C. Aluminum Jacket: ASTM B209 (ASTM B209M).
 1. Thickness: 0.020 inch sheet.
 2. Finish: Embossed.
 3. Joining: Longitudinal slip joints and 2 inch laps.
 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
 6. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

2.07 DUCT LINER

- A. Manufacturers:
 1. Knauf Insulation: www.knaufinsulation.com.
 2. Johns Manville: www.jm.com.
 3. Owens Corning Corp: www.owenscorning.com.
 4. CertainTeed Corporation; Model "ToughGard® Duct Liner": www.certainteed.com.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: Non-corrosive, incombustible glass mineral wool complying with ASTM C 1071; mat faced air stream surface and edges coated with acrylic polymer.
 1. Fungi Resistance: ASTM G 21.
 2. UL GREENGUARD Certified does not support the growth of mold, fungi, or bacteria per ASTM C 1338
 3. Meets UL Environment GREENGUARD Microbial Resistance Listing per UL 2824-"GREENGUARD Certification Program Method for Measuring Microbial Resistance"
 4. DecaBDP Free.
 5. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
 6. Service Temperature: Up to 250 degrees F.
 7. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.
 8. Minimum Noise Reduction Coefficients:
 - a. 1/2 inch Thickness: 0.45.
 - b. 1 inch Thickness: 0.70.
 - c. 1-1/2 inches Thickness: 0.80.
 - d. 2 inch Thickness: 0.85.
- C. Liner Fasteners: Galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that ducts have been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.

- C. Insulated ducts conveying air below ambient temperature:
 - 1. Provide insulation with integral vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated ducts conveying air above ambient temperature:
 - 1. Provide with or without standard vapor barrier jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with canvas jacket sized for finish painting.
- F. Exterior Applications: Provide board insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.
- G. External Duct Insulation Blanket or Board Application:
 - 1. Secure insulation with vapor barrier with mechanical fasteners and seal jacket joints with vapor barrier tape to match jacket.
 - 2. Secure board insulation without vapor barrier with mechanical fasteners (pins and speed washers).
 - 3. Install without sag on underside of duct. Use mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
 - 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive or FSK tape made for duct wrap or FSK board.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- H. Duct and Plenum Liner Application:
 - 1. Adhere insulation with adhesive for 100 percent coverage.
 - 2. Secure insulation with mechanical liner fasteners. Refer to SMACNA HVAC Duct Construction Standards for spacing.
 - 3. Seal and smooth joints. Seal and coat transverse joints.
 - 4. Seal liner surface penetrations with adhesive.
 - 5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.
 - 6. Refer to SMACNA publication for transverse edges for velocities over 2500 fpm.

3.03 SCHEDULES

- A. Outside Air Intake Ducts:
 - 1. Flexible Glass Mineral Wool Duct Insulation: Minimum 2 inches thick or R-Value of 8.
- B. Supply and Return Ducts:
 - 1. Flexible Glass Mineral Wool Duct Insulation: Minimum 1.5 inches thick or R-Value of 5.

END OF SECTION 23 07 13

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 09 90 00 - Painting and Coating: Painting insulation jacket.
- C. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.
- D. Section 23 22 13 - Steam and Condensate Heating Piping: Placement of hangers and hanger inserts.
- E. Section 23 23 00 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

- A. ASTM A 167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip; 2004.
- 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 C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2014.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

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.
- C. 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: Company specializing in performing the type of work specified in this section with minimum three years of documented experience.
- C. Surface-Burning Characteristics: For insulation and related materials, UL/ULC Classified per UL 723 or meeting ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
- D. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
- E. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- F. Formaldehyde Free: Third party certified with UL Environment Validation.
- G. 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).

- H. Recycled Content: A minimum of 50 percent recycled glass content.
- I. 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.
- J. Living Building Challenge-Declare Red List Free.

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.

1.08 DEFINITIONS

- A. Thermal Conductivity (K value): Units of Btu-inch/hour per square foot per degree F.
- B. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no paper exposed.
- C. ASJ: All Service Jacket (no outer film).
- D. SSL+: Self-Sealing Lap with Advanced Closure System.
- E. SSL: Self-Sealing Lap.
- F. FSK: Foil Scrim Kraft; jacketing.
- G. PSK: Poly Scrim Kraft; jacketing.
- H. PVC: PolyVinyl Chloride.
- I. Glass Mineral Wool: Interchangeable with fiber glass, but replacing the term in the attempt to disassociate and differentiate Glass Mineral Wool from the potential health and safety of special purpose or reinforcement products that do not meet the bio solubility criteria of insulation made from glass. Rock Mineral Wool will replace the traditional Mineral Wool label. Both are used in lieu of the Mineral Fiber label.
- J. ECOSE Technology: a revolutionary new binder system based on rapidly renewable bio-based materials; rather than petroleum-based chemicals commonly used in other glass mineral wool insulation materials. ECOSE Technology reduces the binder embodied energy by up to 70 percent and does not contain phenol, formaldehyde, acrylics or artificial colors.
- K. Declare and The Living Building Challenge - The Living Building Challenge is a philosophy, advocacy tool and certification program that addresses development at all scales. The purpose of The Living Building Challenge is to define the most advanced measure of sustainability in the built environment today and acts to diminish the gap between current limits and ideal solutions. Declare supports The Living Building Challenge by providing a transparent materials database that project teams can select from to meet Imperative 11.
- L. Imperative 11, Red List - requires that manufacturers disclose the ingredients in their products to insure that they are free of Red List chemicals and materials. The Red List represents the "worst in class" materials, chemicals and elements known to pose serious risks to human health and the greater ecosystem.
- M. UL Environment Claims Validation (ECV): service and label tests a manufacturer's product and validates that the environmental claims they make in their marketing and packaging materials are factual. This Environmental Claims Validation (ECV) service will allow manufacturers to verify that their products contain a quantifiable amount of recycled content and, as such, help limit raw material extraction and reduce landfill waste. It also will enable products to qualify for LEED® points under Pilot Credit 43: MR - Certified Products.

- N. Recycled content - materials such as bottled glass collected at curbside or other collection sites after consumer use and/or materials used or created from one manufacturing process which are collected as scrap and placed back into another manufacturing process rather than being placed in a landfill or incinerated.
- O. Polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE fire retardants: have been linked to adverse health effects after exposure in low concentrations.
- P. UL Classified: UL has tested and evaluated samples of the product with respect to certain properties of the product. UL Classifies products to:
 - 1. Applicable UL requirements.
 - 2. Standards for safety.
 - 3. Standards of other National and International organizations.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
- B. Materials shall not contain pentabrominated diphenyl ethers (PBDEs) in amounts greater than allowed by Oregon law.

2.02 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
 - 1. Armacell LLC; Armacell II: www.armacell.us.
 - 2. Halstead; Model "Insul-Tube".
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: -40 degrees F.
 - 2. Maximum Service Temperature: 220 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.

2.03 JACKETS

- A. PVC Plastic.
 - 1. Manufacturers:
 - a. Johns Manville Corporation; Model "Zeston 2000": www.jm.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 20 mil.
 - e. Connections: Brush on welding adhesive.
 - 3. Covering Adhesive Mastic:
 - a. Compatible with insulation.
- B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
 - 1. Lagging Adhesive:
 - a. Compatible with insulation.
- C. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - 1. Manufacturers:
 - a. Childers Products Co.: www.fosterproducts.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Thickness: 0.016 inch sheet.

3. Finish: Embossed.
 4. Joining: Longitudinal slip joints and 2 inch laps.
 5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 6. Metal Jacket Bands: 3/8 inch wide; 0.02 inch thick aluminum, or 3/8 inch wide; 0.015 inch thick stainless steel.
- D. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
1. Thickness: 0.010 inch.
 2. Finish: Smooth.
 3. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested 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 NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- G. Inserts and Shields:
 1. Application: Piping 1-1/2 inches 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 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.
- H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 84 00.
- I. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.
- J. Exterior Applications: Provide vapor barrier jacket. Insulate fittings as an alternative, provide Knauf RediKlad pipe covering, 0 perms, damage resistant, outdoor weatherable 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. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.
- K. 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.

3.03 SCHEDULE

- A. Cooling Systems:
 1. Refrigerant Suction:
 - a. Elastomeric Cellular Foam Insulation:
 - 1) Pipe Size Range: 1 inch and under.

- 2) Thickness: 1/2 inch.
 - 3) Pipe Size Range: 1-1/4 to 2 inch.
 - 4) Thickness: 3/4 inch.
 - 5) Pipe Size Range: Over 2 inch.
 - 6) Thickness: 1 inch.
2. Refrigerant Hot Gas:
- a. Elastomeric Cellular Foam Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: As recommended by authorized factory representative.

END OF SECTION 23 07 19

SECTION 23 10 05
FUEL PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe, pipe fittings, valves, and connections for piping systems.
- B. Natural gas piping above grade.
- C. Flexible pipe/connectors.
- D. Unions and flanges.
- E. Strainers.
- F. Natural gas pressure regulators.
- G. Natural gas pressure relief valves.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 08 31 00 - Access Doors and Panels.
- C. Section 09 90 00 - Painting and Coating.
- D. Section 23 05 48 - Vibration Isolation and Sound and Seismic Controls for HVAC Piping and Equipment.
- E. Section 23 05 49 - HVAC Seismic Restraint.
- F. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- G. Section 26: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 2013.
- B. ASME B31.1 - Power Piping; The American Society of Mechanical Engineers; 2013 (ANSI/ASME B31.1).
- C. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2013 (ANSI/ASME B31.9).
- D. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers; 2013.
- E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2013.
- F. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2013.
- G. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2009.
- H. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2006.
- I. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2010.
- J. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2009.
- K. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.
- L. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2012.

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.
- 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. Valve Repacking Kits: Two for each type and size of valve.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with all applicable local codes and standards.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Conform to ASME (BPV IX) .
- D. Welder Qualifications: Certified in accordance with ASME (BPV IX).
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, water pressure rating.

1.06 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with applicable plumbing code.
- B. Conform to applicable code for installation of backflow prevention devices.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.07 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. Store pipe on sleepers, a minimum of 4 inches above surrounding grade, at all times.

1.08 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A 53/A 53M Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A 234/A 234M, wrought steel welding type.
 - 2. Joints: NFPA 54, threaded or welded to ASME B31.1.

2.02 REGULATOR VENT PIPING, ABOVE GRADE

- A. Same as natural gas piping, above grade.

2.03 STAINLESS STEEL GAS CONNECTORS

- A. Manufacturers:
 - 1. Dormont, or approved equal.
- B. Features and Specifications:
 - 1. Tubing: Annealed, 304 stainless steel (ASTM A240).
 - 2. Flare Nuts: Brass or plated steel.
 - 3. Adaptors: Brass or plated steel.
 - 4. Coating: Heavy-duty, antimicrobial, hot-dipped gray PVC (for 1/2" OD (21 series) and 5/8" OD (31 series only). Coating will not hold a flame.
 - 5. Approved for indoor/outdoor use with stationary gas appliances/equipment.
 - 6. Temperature rating of connector with adapters: -40°F to 150°F.

7. Temperature rating with valves: -40°F to 125°F.
8. 100% factory leak tested
9. When installing a new appliance or when an existing appliance is moved to a new location a NEW gas connector must be used per manufacturer's installation instructions and per product standards ANSI Z21.24/CSA 6.10 and ANSI Z21.75/CSA 6.27
10. Designed for occasional movement after installation. Repeated bending, flexing or extreme vibration must be avoided. Normal operation of a clothes dryer, rooftop HVAC unit or SIMILAR OUTDOOR APPLIANCE DOES NOT constitute extreme vibration or movement

C. Design Certifications and Approvals:

1. ANSI Z21.24/CSA 6.10 - Connectors for Gas Appliances
2. ANSI Z21.75/CSA 6.27 - Connectors for Outdoor Appliances and Manufactured Homes

2.04 STRAINERS

A. Manufacturers:

1. Muller Steam Specialty.
2. O.C. Keckley Company.
3. Spirax Sarco, Inc.

- B. 2 inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

2.05 EQUIPMENT NATURAL GAS PRESSURE REGULATORS

A. Manufacturers:

1. Equimeter.
2. American.
3. Maxitrol.
4. Sensus.

- B. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.

1. Comply with ANSI Z21.80.
2. Temperatures: Minus 20 degrees F to 150 degrees F.
3. Body: Cast iron with neoprene gasket.
4. Spring case, lowered diaphragm casing, union ring, seat ring and disk holder: Aluminum.
5. Disk, Diaphragm, and O-Ring: Nitrile.
6. Minimum Inlet Pressure: 5 psi.
7. Furnish sizes 2 inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.

2.06 GAS PRESSURE RELIEF VALVES

A. Manufacturers:

1. Fisher.
2. American.
3. Or approved equal.

- B. Product Description: Spring loaded type relief valve.

1. Body: Aluminum.
2. Diaphragm: Nitrile.
3. Orifice: Stainless Steel.
4. Maximum Operating Temperature: 150 degrees F.
5. Inlet Connections: Threaded.
6. Outlet or Vent Connection: Same size as inlet connection.

2.07 GAS VENT TERMINALS

- A. 3/4 inch and one (1) inch aluminum threaded vent terminal with 16 x 16 mesh 0.018 gauge stainless steel screen.

- B. 1-1/4 inch to 4 inch standard pipe threaded elbow with 12 x 12 mesh stainless steel screen.
 - 1. Equal to Upsco Inc.
- C. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.

2.08 VALVES

- A. Manual Shut-off Valves Inside Building.
 - 1. Manufacturer:
 - a. Nordstrom.
 - b. Fisher
 - c. Grinnel
 - 2. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
 - a. CWP Rating: 125 psig.
 - b. Threaded Ends: Comply with ASME B1.20.1.
 - c. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 - d. Tamperproof Feature: Locking feature for valves where required by Con. Ed.
 - e. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 - f. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
 - g. Threaded cast iron body, 125 PSIG WOG.
 - 3. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
 - a. CWP Rating: 125 psig.
 - b. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 - c. Tamperproof Feature: Locking feature for valves where required by Con. Ed.
 - d. Service Mark: Initials "WOG" shall be permanently marked on valve body.
 - e. 2½ in. to 4-in.: Flanged cast iron body lubricated tapered plug type, 175 psig WOG.
 - f. 6 in. and larger: Flanged cast iron body lubricated tapered plug type, 200 psig WOG, worm gear operated.
 - 4. Provide 2 wrenches for each size used.
 - a. Attach wrench to each valve.
- B. Ball Valves
 - 1. Manufacturer:
 - a. Contromatics.
 - b. Cornbraco
 - c. NIBCO
 - 2. On local branches three inches and smaller, provide threaded three piece full port wafer-type ball valve with bronze body, ball stem, Teflon seats, and level handles, 300 psig WOG, AGA approved.
- C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
 - 1. 2 inch and smaller: Threaded brass ball valves with full port TFE seats and blowout proof stem, 600 psig WOG, AGA approved.

2. Manufacturers:
 - a. BrassCraft.
 - b. Conbraco.
 - c. NIBCO.
 3. Body: Bronze, complying with ASTM B 584.
 4. Ball: Chrome-plated bronze.
 5. Stem: Bronze; blowout proof.
 6. Seats: Reinforced TFE; blowout proof.
 7. Packing: Threaded-body packnut design with adjustable-stem packing.
 8. Ends: Threaded, flared, or socket.
 9. CWP Rating: 600 psig.
 10. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 11. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Bronze Plug Valves: MSS SP-78.
1. Manufacturers:
 - a. Hammond.
 - b. Lee Brass Company.
 - c. NIBCO.
 2. Body: Bronze, complying with ASTM B 584.
 3. Plug: Bronze.
 4. Ends: Threaded, socket, or flanged.
 5. Operator: Square head or lug type with tamperproof feature where indicated.
 6. Pressure Class: 125 psig.
 7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction, AGA approved.
 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Cast-Iron, Non-lubricated Plug Valves: MSS SP-78.
1. Manufacturers:
 - a. McDonald.
 - b. Mueller Co.
 - c. Xomox Corporation.
 2. Body: Cast iron, complying with ASTM A126, Class B.
 3. Plug: Bronze or nickel-plated cast iron.
 4. Seat: Coated with thermoplastic.
 5. Stem Seal: Compatible with natural gas.
 6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 7. Operator: Square head or lug type with tamperproof feature where indicated.
 8. Pressure Class: 125 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. Cast Lubricated Plug Valves Inside Building:
1. 2-inch and smaller: Cast iron body, threaded, equal to Nordstrom Valves, Inc. Figure 114.
 2. 2½ inch to 4-inch: Flanged cast iron body lubricated tapered plug type, 175 psig WOG, equal to Nordstrom Valves, Inc. Figure 115.
 3. 6 inch and larger: Flanged cast iron body lubricated tapered plug type, 200 psig WOG, worm gear operated, equal to Nordstrom Valves, Inc. Figure 165.
 4. Valves 2 ½ inch and larger shall be flanged.
 5. Provide 2 wrenches for each size used.
 6. Attach wrench to each valve.
 7. Gas Cocks:

- a. Gas cocks shall be for use only as manual gas shut-off valves at each piece of gas burning equipment; shall be of the plug type, bronze construction with check, nut and washer bottom and tee handle.
- b. Gas cocks shall be Figure 10596 as manufactured by A.Y. McDonald Mfg. Co., or Series 52 as manufactured by Conbraco Industries, Inc.
- c. Gas cocks shall only be used on piping 1 inch and smaller.

2.09 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 Inches 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 Size Over 1 Inch:
 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. Dielectric Connections: Bronze threaded nipple, minimum 3 inches long, with impervious isolation liner. Victaulic "Clearflow".

2.10 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 1. Tolco Inc.
 2. Anvil.
 3. Hubbard Enterprises/Holdrite.
 4. Michigan Hanger Company, Inc.
 5. PHD Manufacturing Co.
 6. Superstrut.
 7. Unistrut.
 8. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fuel Piping:
 1. Conform to ASME B31.9.
 2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 7. Vertical Support: Steel riser clamp.
 - a. Isolate riser clamp from structure by use of Hubbard Enterprises/Holdrite #274 or #278 riser pad or Owner-approved equivalent.
 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 10. Use non-metallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
 11. For vertical midspan support of piping 4 inches and under, use Hubbard Enterprises/Holdrite Stout Bracket in conjunction with Hubbard Enterprises/Holdrite Stout Clamp or industry standard two-hole pipe clamp (MSS Type 26).
 12. Secondary Pipe Positioning and Supports:
 - a. Makeshift, field-devised methods of plumbing pipe support, such as the use of scrap framing materials, are not allowed. Support and positioning of piping shall be by means of engineered methods that comply with IAPMO PS 42-96. These are to be Hubbard Enterprises/Holdrite support systems or approved equal.

- C. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 - 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
 - 6. Other Types: As required.
 - 7. Manufacturers:
 - a. Powers Fasteners, Inc.: www.powers.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.11 ACCESSORIES

- A. Hanger Rods: Mild steel, threaded both ends, threaded on one end, or continuous threaded.

2.12 INSERTS

- A. Manufacturers:
 - 1. Anvil Fig. 281.
 - 2. PHD Fig 951.
 - 3. Michigan Hanger Model 355EG.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Inserts: Carbon steel case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.13 FLASHING

- A. Metal Flashing: 26 gage thick galvanized steel.
- B. Metal Counterflashing: 22 gage thick galvanized steel.
- C. Lead Flashing:
 - 1. Waterproofing: 5 lb./sq.ft. sheet lead
 - 2. Soundproofing: 1 lb./sq.ft. sheet lead.
- D. Flexible Flashing: 1.85 inch thick sheet butyl; compatible with roofing.
- E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.14 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sealant: Acrylic; refer to Section 07 90 05.

2.15 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc. Model Series LS.
 - 2. NMP Corporation.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.16 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Unistrut Model Series P1000.
 - 2. Superstrut Model Series 1200.
 - 3. Michigan Hanger "O-Strut" Model A-12.

4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.17 FIRESTOPPING

- A. Manufacturers:
1. Specified Technology Inc. (STI) Model SpecSeal Series 100.
 2. Dow Corning Corp.
 3. Hilti Corp.
 4. International Protective Coating Corp.
 5. 3M fire Protection Products.
 6. Metacaulk Fire Stopping: www.rectorseal.com.
 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
1. Silicone Firestopping Elastomeric Firestopping: Single or multiple component silicone elastomeric compound and compatible silicone sealant.
 2. Foam Firestopping Compounds: Single or Multiple component foam compound.
 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: As selected from manufacturer's full range of colors.

2.18 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
1. Mineral fiberboard.
 2. Mineral fiber matting.
 3. Sheet metal.
 4. Plywood or particle board.
 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
1. Furnish UL listed products.
 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

2.19 PRESSURE GAGES

- A. 4½ in. diameter, black enamel coated steel case ring with shatterproof glass, ½ in. bronze bellows with brass socket, blow out on back of case, ¼ in. bottom outlet connection, similar to

Trerice No. 860 or Weksler Instruments Corp. No. BL14-PWE4-LWXX with 0 to 27 in. of water column dial, brass pressure snubber and brass tee-handle cock.

- B. Locate pressure gauges on inlet and outlet of gas booster pressure pump, at farthest point in system and as noted.

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. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- C. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 00.
- G. Establish elevations of buried piping outside the building to ensure not less than 2 ft of cover.
- H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- I. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 90 00.
- J. Install valves with stems upright or horizontal, not inverted.
- K. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- L. Sleeve pipes passing through partitions, walls and floors.
- M. 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.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. For pipe runs of 1 inch or less and ran high and tight to the structure, use Hubbard Enterprises/Holdrite #121 or #125 Series Brackets in conjunction with Hubbard Enterprises/Holdrite #260 or #400 Series Inserts or approved equal.
 - 6. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- N. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9 and MSS SP-89.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.

5. Use hangers with 1-1/2 inch 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 or sheet lead packing between hanger or support and piping.
9. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 23 05 48.
11. Support of pipe tubing and equipment is to be accomplished by means of engineered products specific to each application. Makeshift field devised methods will not be allowed.

3.04 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Provide plug valves in natural gas systems for shut-off service.

END OF SECTION 23 10 05

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Pressure relief valves.
- H. Filter-driers.
- I. Solenoid valves.
- J. Expansion valves.
- K. Receivers.
- L. Flexible connections.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 08 31 00 - Access Doors and Panels.
- C. Section 09 90 00 - Painting and Coating.
- D. Section 23 07 19 - HVAC Piping Insulation.
- E. Section 23 81 27 - Split-System Heating and Cooling
- F. Division 26: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. AHRI 495 - Performance Rating of Refrigerant Liquid Receivers; 2005.
- B. AHRI 710 - Performance Rating of Liquid-Line Driers; 2009.
- C. AHRI 730 (I-P) - Flow Capacity Rating of Suction-Line Filters and Suction-Line Filter-Driers; 2013.
- D. AHRI 750 - Standard for Thermostatic Refrigerant Expansion Valves; 2007.
- E. AHRI 760 - Standard for Performance Rating of Solenoid Valves for Use With Volatile Refrigerants; 2007.
- F. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.
- G. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2013.
- H. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2015.
- I. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
- J. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- K. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2013.
- L. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2013.
- M. ASME B31.9 - Building Services Piping; 2014.
- N. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

- O. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- P. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2015.
- Q. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
- R. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
- S. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2013.
- T. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.
- U. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (Errata 2016).
- V. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.
- W. UL 429 - Electrically Operated Valves; Current Edition, Including All Revisions.

1.04 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.
- C. Liquid Indicators:
 - 1. Use line size liquid indicators in main liquid line leaving condenser.
 - 2. If receiver is provided, install in liquid line leaving receiver.
 - 3. Use line size on leaving side of liquid solenoid valves.
- D. Valves:
 - 1. Use service valves on suction and discharge of compressors.
 - 2. Use gage taps at compressor inlet and outlet.
 - 3. Use gage taps at hot gas bypass regulators, inlet and outlet.
 - 4. Use check valves on compressor discharge.
 - 5. Use check valves on condenser liquid lines on multiple condenser systems.
- E. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
- F. Strainers:
 - 1. Use line size strainer upstream of each automatic valve.
 - 2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
 - 3. On steel piping systems, use strainer in suction line.
 - 4. Use shut-off valve on each side of strainer.
- G. Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.
- H. Filter-Driers:
 - 1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.
 - 2. Use a filter-drier on suction line just ahead of compressor.
 - 3. Use sealed filter-driers in lines smaller than 1/2 inch outside diameter.
 - 4. Use sealed filter-driers in low temperature systems.
 - 5. Use sealed filter-driers in systems utilizing hermetic compressors.
 - 6. Use replaceable core filter-driers in lines of 1/2 inch outside diameter or greater.
 - 7. Use replaceable core liquid-line filter-driers in systems utilizing receivers.
 - 8. Use filter-driers for each solenoid valve.
- I. Solenoid Valves:

1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.
 2. Use in liquid line of single or multiple evaporator systems.
 3. Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.
- J. Receivers:
1. Use on systems 20 tons and larger, sized to accommodate pump down charge.
 2. Use on systems with long piping runs.
- K. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.
- C. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.
- D. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Test Reports: Indicate results of leak test, acid test.
- F. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.
- G. Submit welders certification of compliance with ASME (BPV IX).
- H. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.
- I. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.
- 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 Filter-Dryer Cartridges: Two of each type and size.
 3. Refrigeration Oil Test Kits: Two, each containing everything required to conduct one test.
 4. Extra Refrigerant: Two containers of refrigerant, 40 pounds size.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design piping system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in Oregon.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.07 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
- C. Welders Certification: In accordance with ASME (BPV IX).
- D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.01 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy.
- B. Copper Tube to 7/8 inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
 - 1. Fittings: ASME B16.26 cast copper.
 - 2. Joints: Flared.
- C. Steel Pipe: ASTM A53/A53M, Schedule 40, black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Welded in accordance with AWS D1.1.
- D. Steel Pipe Sizes 12 Inch and Over: ASTM A53/A53M, 0.375 inch wall, black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Welded in accordance with AWS D1.1.
- E. Pipe Supports and Anchors:
 - 1. Provide hangers and supports that comply with MSS SP-58.
 - a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.
 - 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 - 6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 - 10. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
 - 11. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
 - 12. 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/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 under pipe to top of roofing.
 - f. Manufacturers:
 - 1) PHP Systems/Design: www.phpsd.com.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

2.02 REFRIGERANT

- A. Refrigerant: R-410A as defined in ASHRAE Std 34.

2.03 MOISTURE AND LIQUID INDICATORS

- A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.04 VALVES

- A. Diaphragm Packless Valves:
 - 1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- B. Packed Angle Valves:
 - 1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- C. Ball Valves:
 - 1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.
- D. Service Valves:
 - 1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi.

2.05 STRAINERS

- A. Straight Line or Angle Line Type:
 - 1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.
- B. Straight Line, Non-Cleanable Type:
 - 1. Steel shell, copper plated fittings, stainless steel wire screen, for maximum working pressure of 425 psi.

2.06 CHECK VALVES

- A. Globe Type:
 - 1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 425 psi.
- B. Straight Through Type:
 - 1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.

2.07 PRESSURE REGULATORS

- A. Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psi range, for maximum working pressure of 450 psi.

2.08 PRESSURE RELIEF VALVES

- A. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 235 psi.

2.09 FILTER-DRIERS

- A. Performance:
 - 1. Flow Capacity - Rated in accordance with AHRI 710.
 - 2. Flow Capacity - Rated in accordance with AHRI 730.
 - 3. Water Capacity: Rated in accordance with AHRI 710.

4. Water Capacity: As indicated in schedule, rated in accordance with AHRI 710.
 5. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
 6. Design Working Pressure: 350 psi, minimum.
- B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.
- C. Construction: UL listed.
1. Replaceable Core Type: Steel shell with removable cap.
 2. Sealed Type: Copper shell.
 3. Connections: As specified for applicable pipe type.

2.10 SOLENOID VALVES

- A. Valve: AHRI 760, pilot operated, copper body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psi.
- B. Coil Assembly: UL 429, UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

2.11 EXPANSION VALVES

- A. Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, mechanical pressure limit (maximum operating pressure MOP feature), adjustable superheat setting, replaceable inlet strainer, with non-replaceable capillary tube and remote sensing bulb and remote bulb well.
- B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.12 ELECTRONIC EXPANSION VALVES

- A. Valve:
1. Brass body with flared or solder connection, needle valve with floating needle and machined seat, stepper motor drive.
- B. Evaporation Control System:
1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, preselection allowance for electrical defrost and hot gas bypass.
- C. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

2.13 RECEIVERS

- A. Internal Diameter 6 inch and Smaller:
1. AHRI 495, UL listed, steel, brazed; 400 psi maximum pressure rating, with tappings for inlet, outlet, and pressure relief valve.
- B. Internal Diameter Over 6 inch:
1. AHRI 495, welded steel, tested and stamped in accordance with ASME (BPV VIII, 1); 400 psi with tappings for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.

2.14 FLEXIBLE CONNECTORS

- A. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. 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.
 - 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 recessed into and grouted flush with slab.
- G. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.5, ASTM F 708, and MSS SP-89.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.
 - 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 7. Provide copper plated hangers and supports for copper piping.
- H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- I. Provide clearance for installation of insulation and access to valves and fittings.
- J. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Section 08 31 00.
- K. Flood piping system with nitrogen when brazing.
- L. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- M. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 90 00.
- N. Insulate piping; refer to Section .
- O. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- P. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

- Q. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- R. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- S. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- T. Fully charge completed system with refrigerant after testing.
- U. Provide electrical connection to solenoid valves. Refer to Section 26 05 83.

3.03 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. Pressure test system with dry nitrogen to 200 psi. Perform final tests at 27 inches vacuum and 200 psi using electronic leak detector. Test to no leakage.

3.04 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
 - 1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - 2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 - 3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 - 4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.
- B. Hanger Spacing for Steel Piping.
 - 1. 1/2 inch, 3/4 inch, and 1 inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 3. 1-1/2 inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. 2 inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 5. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.

END OF SECTION 23 23 00

SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal ductwork.
- B. Casing and plenums.
- C. Duct cleaning.
- D. Duct systems have been designed for metal duct.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 07 84 00 - Firestopping.
- D. Section 23 05 48 - Vibration Isolation and Sound and Seismic Controls for HVAC Piping and Equipment.
- E. Section 23 05 49 - HVAC Seismic Restraint.
- F. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- G. Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- H. Section 23 33 00 - Air Duct Accessories.
- I. Section 23 37 00 - Air Outlets and Inlets.

1.03 REFERENCE STANDARDS

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2013.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. 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; 2015.
- E. 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.
- F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- I. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- J. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2012.
- K. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- L. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2015.
- M. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- N. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.

- O. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2014.
- P. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for duct materials, duct liner, duct connections, and duct fittings.
- C. Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:
 - 1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
 - 2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust duct systems, indicate classification of materials handled as defined in this section.
 - 3. Fittings.
 - 4. Reinforcing details and spacing.
 - 5. Seam and joint construction details.
 - 6. Penetrations through fire rated and other walls.
 - 7. Terminal unit, coil, and humidifier installations.
 - 8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
- D. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.
- E. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meet or exceed recommended fabrication and installation requirements.
- F. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

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.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.06 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A, NFPA 90B, and NFPA 96 standards.

1.07 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.
- B. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.
- C. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - 2. VOC Content: Not more than 250 g/L, excluding water.
 - 3. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E84.

4. For Use With Flexible Ducts: UL labeled.
5. Products:
 - a. Duro-Dyne; Model DSW: www.durodyne.com.
 - b. Hard Cast; Model RTA 50: www.hardcast.com.
 - c. Hard Cast; Model "Versa-Grip" 102: www.hardcast.com.
 - d. Sika; Model "Sikaflex": www.sika.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- E. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
 6. Other Types: As required.
 7. Manufacturers:
 - a. Powers Fasteners, Inc.: www.powers.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- F. All Ducts: Galvanized steel, unless otherwise indicated.

2.02 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- B. Transfer Air and Sound Boots: 1/2 inch w.g. pressure class, fibrous glass.
- C. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE Handbook - Fundamentals.
- D. Duct systems have been designed for metal duct. At the Contractor's option, fibrous glass duct may be substituted for metal duct.
- E. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- F. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
- G. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
- H. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- I. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards.
- J. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- K. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.03 DUCT MANUFACTURERS

- A. Streimer Sheet Metal: www.streimer.com.
- B. General Sheet Metal: www.gsmw.com.
- C. Arctic Sheet Metal: www.arcticsheetmetal.com.

- D. Arjae Sheet Metal: www.arjae.com.
- E. Robert Lloyd Sheet Metal: www.rlsm.net.
- F. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

- A. Flexible Ducts: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
 - 1. Insulation: Fiberglass insulation with polyethylene or aluminized vapor barrier film.
 - 2. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
 - 3. Maximum Velocity: 4000 fpm.
 - 4. Temperature Range: -20 degrees F to 210 degrees F.
 - 5. Minimum Insulation: R-6
 - 6. Manufacturers:
 - a. Thermaflex.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Transverse Duct Connection System: SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.

2.05 CASINGS

- A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards and construct for operating pressures indicated.
- B. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.
- C. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
 - 1. Provide clear wire glass observation ports, minimum 6 X 6 inch size.
- D. Fabricate acoustic casings with reinforcing turned inward. Provide 16 gage back facing and 22 gage perforated front facing with 3/32 inch diameter holes on 5/32 inch centers. Construct panels 3 inches thick packed with 4.5 lb/cu ft minimum glass fiber media, on inverted channels of 16 gage.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards.
- B. Install in accordance with manufacturer's instructions.
- C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- D. Flexible Ducts: Connect to metal ducts with adhesive and draw bands
- E. Underground Ducts: Slope to plenums or low pump out points at 1:500. Provide access doors for inspection.
- F. Use sealant on all lapped round duct joint connections. Seal all ducts in accordance with State Energy Code.
- G. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- H. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

- I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- J. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
- K. Install duct hangers and supports in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- L. Use double nuts and lock washers on threaded rod supports.
- M. Connect terminal units to supply ducts with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
- N. Connect diffusers or light troffer boots to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.
- O. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.

3.02 CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- B. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

3.03 SCHEDULES

- A. Ductwork Material Schedule:

<u>AIR SYSTEM</u>	<u>MATERIAL</u>
Supply (Heating Systems)	Steel, Aluminum
Supply (System with Cooling Coils)	Steel, Aluminum
Return	Steel, Aluminum
Outside Air Intake	Steel

- B. Ductwork Pressure Class Schedule:

<u>AIR SYSTEM</u>	<u>PRESSURE CLASS</u>
Supply (Heating Systems)	1 inch wg
Supply (System with Cooling Coils)	1 inch wg
Return	1 inch wg

END OF SECTION 23 31 00

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Duct access doors.
- B. Duct test holes.
- C. Flexible duct connections.
- D. Volume control dampers.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 23 05 48 - Vibration Isolation and Sound and Seismic Controls for HVAC Piping and Equipment.
- C. Section 23 31 00 - HVAC Ducts and Casings.
- D. Division 26 - Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
- D. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.
- E. Project Record Drawings: Record actual locations of access doors, test holes, fire dampers, and fire and smoke dampers.

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.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Cesco; Model Series HF: www.cescoproducts.com.
 - 2. Greenheck; Model Series HAD/CAD: www.greenheck.com.
 - 3. Ruskin Company: www.ruskin.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.

1. Less Than 12 inches Square: Secure with sash locks.
2. Up to 18 inches Square: Provide two hinges and two sash locks.
3. Up to 24 x 48 inches: Three hinges and two compression latches with outside and inside handles.
4. Larger Sizes: Provide an additional hinge.

C. Access doors with sheet metal screw fasteners are not acceptable.

2.02 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.03 FLEXIBLE DUCT CONNECTIONS

- A. Manufacturers:
 1. Carlisle HVAC Products; Dynair Connector Plus G90 Steel Offset Seam Neoprene Fabric: www.carlislehvac.com/sle.
 2. Elgen Manufacturing: www.elgenmfg.com.
 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- C. Flexible Duct Connections: Fabric crimped into metal edging strip.
 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
 - a. Net Fabric Width: Approximately 3 inches wide.
 2. Metal: 3 inches wide, 24 gage thick galvanized steel.
- D. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.
- E. Maximum Installed Length: 14 inch.

2.04 VOLUME CONTROL DAMPERS

- A. Manufacturers:
 1. Cesco; Model Series MGF/MGG: www.cescoproducts.com.
 2. Greenheck; Model Series MBD/MBDR: www.greenheck.com.
 3. Nailor; Model 1110/1120 galvanized: www.nailor.com.
 4. Tamco; Series 1000 (aluminum): www.tamco.com.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- C. Splitter Dampers:
 1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
 2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
 3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
 4. Manufacturers:
 - a. Krueger.
- D. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.
 1. Fabricate for duct sizes up to 6 x 30 inch.
 2. Blade: 24 gage, minimum.
 3. Manufacturers:
- E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

1. Blade: 18 gage, minimum.
2. Manufacturers:
 - a. Ruskin.
- F. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.
 1. Product: 515A manufactured by Young Regulator.
- G. Quadrants:
 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 3. Where rod lengths exceed 30 inches provide regulator at both ends.
 4. Products:
 - a. 443 Valcalox Regulator manufactured by Young Regulator.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
- C. Provide duct test holes where indicated and required for testing and balancing purposes.
- D. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- E. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment; see Section 23 05 48.
- F. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- G. Use splitter dampers only where indicated.
- H. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION 23 33 00

SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Registers/grilles.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating: Painting of ducts visible behind outlets and inlets.

1.03 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2012.
- B. ARI 890 - Standard for Air Diffusers and Air Diffuser Assemblies; Air-Conditioning and Refrigeration Institute; 2008.
- C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; 2006 (R2011).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
- C. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
- B. Test and rate louver performance in accordance with AMCA 500-L.

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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carnes, a division of Carnes Company Inc.: www.carnes.com.
- B. Krueger: www.krueger-hvac.com.
- C. Price Industries: www.price-hvac.com.
- D. Titus: www.titus-hvac.com.
- E. Nailor; www.nailor.com.
- F. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 WALL SUPPLY REGISTERS/GRILLES

- A. Manufacturers:
 - 1. Carnes Model Series RTDB.
 - 2. Price Model Series 520.
 - 3. Krueger Model 880.
 - 4. Titus Model 300RL.
 - 5. Nailor; Model 6145H.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, horizontal face, double deflection.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

- D. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory off-white enamel finish.
- E. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.
- F. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.03 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Manufacturers:
 - 1. Carnes Model Series RSAB.
 - 2. Price Model Series 530.
 - 3. Krueger Model S80.
 - 4. Titus Model 350RL.
 - 5. Nailor; Model 49-241.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, horizontal face.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting.
- D. Fabrication: Steel frames and blades, with factory off-white enamel finish.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.
- F. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 90 00.

END OF SECTION 23 37 00

SECTION 23 55 33
FUEL-FIRED UNIT HEATERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fuel fired packaged air units.
- B. Controls.

1.02 RELATED REQUIREMENTS

- A. Section 22 05 48 - Vibration Isolation and Sound and Seismic Controls for Plumbing Piping and Equipment.
- B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Fan motors.
- C. Section 23 05 48 - Vibration Isolation and Sound and Seismic Controls for HVAC Piping and Equipment.
- D. Section 23 0549 - HVAC Seismic Restraint.
- E. Section 23 07 13 - Duct Insulation: Duct Liner.
- F. Section 23 09 13 - Instrumentation and Control Devices for HVAC: Thermostats, time clocks.
- G. Section 23 31 00 - HVAC Ducts and Casings.
- H. Section 23 51 00 - Breechings, Chimneys, and Stacks.
- I. Division 26: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013, Including All Amendments and Errata.
- B. ASHRAE Std 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers; 2007, Including All Amendments.
- C. NFPA 54 - National Fuel Gas Code; 2015.
- D. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.
- E. NFPA 211 - Guide for Smoke and Heat Venting; 2013, Including All Amendments.
- F. UL 729 - Oil-Fired Floor Furnaces; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's literature and data indicating rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and locations and sizes of field connections.
- D. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listing.
- F. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Project Requirements, for additional provisions.
 - 2. Extra Filters: Two sets.

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 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide ten year manufacturers warranty for heat exchangers.

PART 2 PRODUCTS

2.01 FUEL FIRED PACKAGED AIR UNITS

- A. Manufacturer: Reznor Model RDH.
- B. Other acceptable manufacturers offering equivalent products.
 - 1. Modine.
 - 2. Sterling.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet and supply fan assembly, and duct furnaces each consisting of heat exchanger and burner.
- D. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors, glass fiber insulation and reflective liner.
- E. Supply Fan: Centrifugal type rubber mounted with belt drive, variable pitch motor pulley.
- F. Filter: 1 inch thick glass fiber throw-away type, located to filter air before fan.
- G. Gas Fired Duct Furnace Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, heat exchanger, burner, controls, and accessories.
 - 1. Heat Exchanger: Aluminized steel welded construction.
 - 2. Gas Burner:
 - a. Atmospheric type with adjustable combustion air supply,
 - b. Gas valve, two stage provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.
 - c. Electronic pilot ignition, with electric spark igniter.
 - d. Combustion air damper with synchronous spring return damper motor.
 - e. Non-corrosive combustion air blower with permanently lubricated motor.
 - 3. Gas Burner Safety Controls:
 - a. Thermocouple sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
 - b. Flame rollout switch: Installed on burner box and prevents operation.
 - c. Vent safety shutoff sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
 - d. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.
 - 4. Requirements:
 - a. Equipped with intermittent ignition device.
 - b. Equipped with power venting.
 - 5. Performance:
 - a. Ratings: Energy Efficiency Rating (EER)/Coefficient of Performance (COP) not less than requirements of ASHRAE Std 90.1 I-P; seasonal efficiency to ASHRAE Std 103.
- H. Mixing Dampers:
 - 1. Dampers: Outside and return dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper shall fall to closed position.
 - 2. Gaskets: Fit dampers with edge gaskets, maximum leakage 5 percent at 2 inches wg pressure differential.
 - 3. Damper Operator: 24 volt with gear train sealed in oil.

- I. Requirements:
 - 1. Equipped with intermittent ignition device.
 - 2. Equipped with power venting.
- J. Controls:
 - 1. To be provided by PPS Controls Contractor; coordinate control installation.
- K. Performance:
 - 1. Ratings: Energy Efficiency Rating (EER)/Coefficient of Performance (COP) not less than requirements of ASHRAE Std 90.1 I-P; seasonal efficiency to ASHRAE Std 103.
- L. Disconnect Switch: Factory mount disconnect switch in control panel.

2.02 ROOF CURBS

- A. Roof curbs shall be constructed of galvanized steel. Curbs are to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support, and air seal for the unit. Curb gasketing shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit. Curbs shall be provided to fit level on the roof.
 - 1. Provide seismic anchorage calculations and instructions for attaching the unit to structure.
 - 2. Provide elevated discharge curb as noted on the plans.
 - 3. Provide seismic spring vibration isolators.
 - 4. Provide 14inch high seismic vibration isolation curb: MicroMetl, Vibrex, or equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that space is ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available.
- C. Verify that proper fuel supply is available for connection.

3.02 INSTALLATION

- A. Install in accordance with NFPA 90B.
- B. Install gas fired units in accordance with NFPA 54 and applicable codes.
- C. Provide vent connections in accordance with NFPA 211. Refer to Section 23 51 00.
- D. Install unit heaters and packaged air units with vibration isolation. Refer to Section 23 05 48.
- E. Provide operating controls; refer to Section 23 09 13.
- F. Provide connection to electrical power systems; refer to Division 26.

END OF SECTION 23 55 33

SECTION 23 81 27
SMALL SPLIT-SYSTEM HEATING AND COOLING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Split system heat pumps.
- B. Controls.

1.02 RELATED REQUIREMENTS

- A. Division 26: Electrical characteristics and wiring connections and installation and wiring of thermostats and other controls components.

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.
- B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013, Including All Amendments and Errata.
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- D. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- D. Design Data: Indicate refrigerant pipe sizing.
- E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- F. Project Record Documents: Record actual locations of components and connections.
- G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- H. Warranty: Submit manufacturers warranty and ensure forms have been filled out 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.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of documented experience .

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturers warranty for heat exchangers, condensing units, and compressors.

PART 2 PRODUCTS

2.01 OUTDOOR HEAT PUMP UNITS - UP TO 5 TONS

- A. Manufacturer: Trane XR15.
- B. Other Acceptable Manufacturers: Lennox, Carrier, Comfortmaker and Daikin.
- C. Compressor: ARI 520; hermetic, 3600 rpm, resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high-pressure control, motor overload protection, service valves and drier. Furnish time delay control to prevent short cycling.

SMALL SPLIT-SYSTEM HEATING AND COOLING

- D. Refrigeration Accessories: Filter Drier, high-pressure switch (manual reset), low-pressure switch (automatic reset), service valves and gage ports and thermometer well (in liquid line), reversing valve, suction line accumulator, flow control check valve, and solid state defrost control. Furnish thermostatic expansion valves. Furnish refrigerant piping, factory cleaned, dried, pressurized and sealed, with insulated suction line.
- E. Air Cooled Condenser: ARI 520; aluminum fin and copper tube coil, with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
 - 1. Rated cooling output: As indicated on the Drawing Schedules.
- F. Refrigeration Operating Controls:
 - 1. Room Thermostat: Cycles condensing unit and supply fan to maintain room temperature setting.

2.02 HEATING PUMP AIR HANDLING UNITS - UP TO 5 TONS

- A. Manufacturer: Trane TAM.
- B. Other Acceptable Manufacturers: Lennox, Carrier, Rheem, Comfortmaker and Daikin.
- C. Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for 200 psi and 200 degrees F. Provide drain pan under cooling coil, easily removable for cleaning, with drain connection. Provide electric coils where indicated.
- D. Cabinet: 0.0598 inch steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation.
- E. Finish: Factory apply based primer coat on visible surfaces of enclosure or cabinet.
- F. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- G. Motor: Tap would multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.
- H. Control: Coordinate installation with PPS controls contractor.
- I. Filter: Easily removed 1 inch thick glass fiber throw-away type, located to filter air before coil.
- J. Mixing Dampers: Where needed, mixing sections with dampers.

2.03 ROOM THERMOSTATS

- A. Controls to be provided by PPS Controls Contractor; coordinate controls installation.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.
- C. Install refrigeration systems in accordance with ASHRAE Std 15.
- D. Pipe drain from cooling coils to building exterior per drawings.
- E. Consult with roofing manufacturer prior to installation of equipment base. Provide roofing material or rubber pads to protect roof as required by roofing manufacturers/

END OF SECTION 23 81 27

SECTION 26 00 00**BASIC ELECTRICAL MATERIALS AND METHODS****PART 1 GENERAL****1.01 SCOPE**

- A. Project consists of the addition of a new 230 KW, 277/480V, 3 Phase diesel generator with transfer switches.
- B. Provide power and control for a complete and operable system.
- C. Generator shall meet all state and local codes for noise abatement and venting.
- D. Contractor will provide all concrete work associated with the installation and demolition of new equipment.
- E. Removal of all decommissioned electric equipment, panels, etc. offsite will be required.

1.02 DESCRIPTION

- A. Do all work in accordance with regulations of serving electrical utility, telephone utility, National Electrical Code, National Electrical Safety Code, National Fire Codes, International Building Code, and other applicable codes.
- B. Whenever the requirements of the Electrical Specifications or Drawings exceed those of the applicable code or standard, the requirements of the Specifications and Drawings shall govern.
- C. This Contractor is bound by the General Conditions, Supplementary Conditions, Special Conditions, and Division 1 bound herewith in addition to this Specification and accompanying Drawings.
- D. Bidders shall view the site and shall include all costs incurred by existing conditions in the bid proposal.

1.03 QUALITY ASSURANCE

- A. All materials shall be new, of manufacturer's latest design and of the best quality. The materials shall be manufactured in accordance with applicable standards of NEMA, ANSI, or UL and shall be UL listed.
- B. Complete each system as shown and place in operation except where only rough-in or partial systems are called for. Each system shall be tested and left in proper operation free of faults, shorts, or unintentional grounds.
- C. Protect electrical work, wire and cable, materials and equipment installed under this Division against damage by other trades, weather conditions, or any other causes. Equipment found damaged or in other than new condition will be rejected as defective.

1.04 FEES

- A. Secure and pay for all necessary permits and fees. Arrange for all required inspections.

PART 2 PRODUCTS**2.01 OPERATION AND MAINTENANCE OF ELECTRICAL SYSTEMS**

- A. General Electrical Provisions/Design Requirements
 - 1. Design systems that stress durability, resistance to vandalism, and ease of maintenance, reliability, and energy conservation.
 - 2. Evaluate and provide design addressing existing electrical system for:
 - a. Compliance with current codes
- B. Demolition:
 - 1. Coordinate with PPS so that work can be scheduled not to interrupt operations, normal activities or building access.
 - 2. Determine exact location of existing utilities and equipment prior to commencing work and compensate Owner for damages caused by failure to locate or preserve utilities.
 - 3. For items to be demolished: remove wiring, devices and conduit complete, do not abandon in place.

4. Provide temporary wiring and connections to maintain electrical continuity of existing systems during construction. All temporary installations shall be code compliant.
 5. Remove and restore wiring which serves usable existing outlets clear of construction or demolition.
 6. If existing junction boxes will be made inaccessible or if abandoned outlets serve as feed through boxes, provide new conduit and wire to bypass inaccessible junction boxes and abandoned outlets.
- C. Acceptance:
1. Systems are not considered for acceptance until work is complete and demonstrated to meet contract documents.
 2. Acceptance by the Authority Having Jurisdiction (AHJ), or City/ State/ County Inspectors does not demonstrate work meets contract documents.

2.02 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- A. Wire and Cable Conductors:
1. Terminate feeder conductors with indent compression lugs.
 2. Feeder conductors - copper; no substitution.
 3. Aluminum wire prohibited in all sizes.
 4. Insulation for new conductors shall be, "THHN" or "THWN" unless approved by owner.
 5. Conductors No. 18 AWG and larger shall be stranded.
 6. Conductors installed in a manufacturer's standard assembly, such as a light fixture, may be solid wire.
 7. Size feeder conductors for 125% of connected feeder load.
 8. Grounding conductors shall be installed with all new feeders and new branch circuits
 9. Multiple branch circuits in the same conduit may share a common ground conductor
 10. Conductors used for grounding shall be No. 12 AWG minimum.
- B. Installation:
1. Minimum conduit size 3/4 inch unless approved by PPS Electrical Shop.
 2. Install 12 AWG minimum unless stated otherwise on drawings.
 3. Provide dedicated neutrals for:
 - a. Multi-conductor branch circuits fed from a single overcurrent protection device.
 4. Identify wire and cable per 26 05 53, Identification for Electrical Systems.
 5. Test conductor insulation for feeders of 100 amp and greater.(MEGGER)

2.03 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

- A. New services:
1. Provide ground electrodes per code.
- B. Grounding Electrode: soft drawn bare stranded copper for wire sizes larger than 10 AWG bare.
- C. Raceway grounding:
1. Ground metallic raceway systems.
 2. Connect metal raceways, which terminate within an enclosure but without mechanical connection to enclosure by grounding bushings and ground wire to grounding bus.
 3. Install ground conductor in all metallic and non-metallic conduit.
- D. Grounding system resistance not to exceed 5 ohms.

2.04 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- A. Lead type drive anchors shall not be used to anchor electrical equipment, enclosures, and conduit.
- B. Feeder conductors shall be installed in rigid conduits with threaded connections. Pull strings are required in all raceways, pathways and conduits.
- C. Conduit Materials:
1. Approved conduit types shall be Galvanized steel or EMT where specifically approved.

2. Underground 90 degree bends shall be GRC rigid conduit. Treat GRC threads with a copper coat to avoid moisture and corrosion.
 3. Underground conduit shall be Galvanized Rigid Conduit (GRC) or PVC. . GRC required for heavier weight bearing areas and where accessible to vehicular traffic.
 4. Exterior above ground conduit to be Galvanized Rigid Conduit (GRC) if accessible to the public. . No substitutions. No PVC conduit above grade unless authorized by PPS Electric Shop.
 5. EMT allowed on rooftops and areas not accessible by public.
 6. Aluminum conduits prohibited.
- D. Junction Boxes:
1. Exterior junction boxes located below 8 feet from grade to be equipped with security screws.
 2. Underground junction boxes / vaults to be concrete or stainless steel with security screws. Plastic is prohibited
 3. Interior junction boxes: No stacked/ganged boxes allowed beyond one extension ring.
- E. Cast EMT fittings are prohibited.
- F. EMT box connectors shall be steel with nylon throats.
- G. Standard long radius elbows are required or District approved equal. Size branch circuits to allow 4 circuits per classroom.
- H. Use of existing feeder conduit is encouraged when possible.
- I. Flex conduit is prohibited as a substitute for rigid or EMT conduit.
- J. 6 feet maximum length flex conduit is allowed at devices such as motors.
- K. Minimum Conduit Size: 3/4 inch for power and control unless otherwise noted.
- L. Install conduit seals at boundaries where ambient temperatures differ by 10 degrees F or more.
- M. Exposed conduits are permitted only in the following areas:
1. Mechanical and electrical rooms or spaces where walls and ceilings will not be covered with finished materials.
 2. Existing walls that are concrete or block construction.
 3. Route exposed conduit parallel and perpendicular to walls, tight to finished surfaces and neatly offset into boxes.

2.05 IDENTIFICATION OF ELECTRICAL SYSTEMS

- A. Wire Identification
1. Phase, neutral and grounding conductors shall be color-coded at equipment terminals, source, and junction boxes. Colored bands or with continuous color insulation are acceptable.
 2. Wiring for 120/208V or 120/240V systems shall be continuously color coded in accordance with the following schedule:
 - a. Phase A-Black
 - b. Phase B (Orange - Wild leg in 240 V Delta)-Red
 - c. Phase C-Blue
 - d. Neutral-White
 - e. Ground-Green

2.06 SCHEDULES FOR ELECTRICAL

- A. Electrical Record Drawings
1. Exact routing of feeders and service conduits.
 2. Conduit dimensions.
 3. Exact location of junction boxes.
 4. Exact location of conduits installed for future construction. Provide dimensions and depth of burial.

5. All Drawings of Record shall include a one-line diagram including Sub-panels, and note Switchgear/Panel locations by room number.
6. All Switchgear and Panel Schedules shall be listed on Drawings of Record.

2.07 SCHEDULES FOR LOW-VOLTAGE ELECTRICAL DISTRIBUTION

A. Electrical Labeling

1. Nameplates and labels: Engraved stock melamine or lamicoic plastic laminate in size and thickness indicated below, provide 1/8 inch thick material:
 - a. Letter color; white
 - b. Letter height; 1/4 inch.
 - c. Background color; black.
 - d. Locations:
 - 1) Each distribution and control equipment enclosures and panel boards.
 - 2) Communications cabinets.
 - 3) Transformers.
 - 4) Disconnects and starters.
2. Equipment nameplates: Engraved phenolic plastic, 1/16 inch thick.
 - a. Letter color; white
 - b. Letter height; 1/4 inch.
 - c. Background color; black.
3. Hand written labeling is not acceptable
4. Provide typewritten branch panel schedules with clear transparent covers accounting for every breaker installed.
5. Label panels with engraved labels
6. Label junction boxes with panel identification, voltage, and circuit number. Label tape products acceptable.
7. Label devices with panel and circuit numbers. Label tape products acceptable.
8. Label motor controller and disconnects with engraved labels

2.08 BRANCH CIRCUIT PANELS

- A. All panels will be labeled with Arc-Flash hazard level and PPEs required.
- B. Panels shall be Panel Board type and "door in door" construction with hinged doors. Acceptable brands are Square D, Siemens, Cutler Hammer, GE or District approved equal.
- C. Flush lift latch and locks keyed to match building standard.
- D. Use compression lugs on all feeder conductors. Set screw lugs not permitted.
- E. Equipped with molded case thermal magnetic circuit breaker having a minimum interrupting rating of 20,000 A.I.C. or greater if available fault current exceeds 20 A.I.C.
- F. Bolt-on type circuit breakers.
- G. All breakers shall have "SWD" rating.
- H. Permanent numbers, engraved, stamped or painted shall be affixed to each panel next to breakers.
- I. Stick-on numbers are not acceptable.
- J. Panels shall be identified with engraved nameplates.
- K. All branch circuit conductors shall be labeled at breaker with circuit number.
- L. Branch circuit conductors shall be labeled at junction boxes and devices with Panel ID and circuit number.
- M. Lighting: Provide separate panels with switch rated breakers.
- N. Instructional technologies: Provide separate panels sized for 4 receptacle circuits per Non-computer Lab classrooms.
- O. Branch panels: New, 42 circuits, 225 Amp (or larger if load warrants it) 3F, 4 wire with copper buss, with neutral and ground busses rated at 200%. Provide sub- feed lugs for future

connection of additional panel board. Provide isolated ground buss rated the same as neutral buss. Complete hinged cover.

- P. Futures: Flush mounted branch panels. Provide (three) 3/4 inch diameter capped conduits and (two) 1" electrical conduits into accessible spaces above and below.
- Q. Locate branch panels near center of loads.
- R. Panels to be equipped with factory installed transient voltage surge suppression (TVSS) devices built into panels. Factory approved components shall be used where retrofitting panels with TVSS is a factory approved option.
- S. Circuits shall be identified for use and location, including room numbers, in panels with complete panel schedules attached.
- T. Provide handle guards on each circuit supplying obviously constant loads such as fire alarm, security, lighting controls, refrigerators, freezers and fire protection.
- U. Breakers being added to existing panel boards: Coordinate breaker type and short circuit rating with existing panel board. Provide new typed schedule.

2.09 INSTALLATION REQUIREMENTS

- A. Electrical plans are diagrammatic. Verify exact equipment locations for all equipment. Coordinate with architectural drawings and installations to avoid conflicts.
- B. All work shall be installed in a neat, inconspicuous, professional manner. Conduit runs shall parallel structural lines where exposed.
- C. Support conduits nominally every 6 feet along runs and within 18 inches of terminations, ells and fittings. Outlet boxes, fixtures and equipment shall be securely mounted and supported.
- D. The site shall be left clean and free of dirt and debris. Panels, fixtures, outlets and equipment shall be left clean and free of foreign materials and dirt.

PART 3 EXECUTION

3.01 GUARANTEE

- A. Guarantee the electrical installation against all defects in materials, equipment, and workmanship for one year after the date of acceptance of the work. Defects shall be properly remedied to the satisfaction of the Architect at no cost to the Owner.

END OF SECTION 26 00 00