

**SECTION 00 01 01
PROJECT TITLE PAGE**

PROJECT MANUAL

FOR

SECURITY UPGRADES: PHASE 3 CLASSROOM WALLS

BEAVERTON SCHOOL DISTRICT #48J

16550 SW MERLO ROAD
BEAVERTON, OR 97006

PROJECT LOCATIONS:

JACOB WISMER ELEMENTARY SCHOOL

5477 NW SKYCREST PARKWAY
PORTLAND, OR 97229

NANCY RYLES ELEMENTARY SCHOOL

10250 SW CORMORANT DRIVE
BEAVERTON, OR 97007

SCHOLLS HEIGHTS ELEMENTARY SCHOOL

16400 SW LOON DRIVE
BEAVERTON, OR 97007

FINDLEY ELEMENTARY SCHOOL

4155 NW SALTZMAN ROAD
PORTLAND, OR 97229

KINNAMAN ELEMENTARY SCHOOL

4205 SW 193RD AVE
ALOHA, OR 97078

PREPARED BY:

HBX STUDIO ARCHITECTURE INC.

831 SE SALMON ST.
SUITE 140
PORTLAND, OR 97214

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SECTION 00 50 00

CONTRACTING FORMS AND SUPPLEMENTS

PART 1 GENERAL

1.01 AGREEMENT AND CONDITIONS OF THE CONTRACT

1.02 FORMS

- A Use the following forms for the specified purposes unless otherwise indicated elsewhere in Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 00 50 00

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SUBSTITUTION REQUEST

(During the Bidding/Negotiating Stage)

Project: _____ Substitution Request Number: _____

From: _____

To: _____ Date: _____

A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

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

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

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.
- 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.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

A/E's REVIEW AND ACTION

- ☐ Substitution approved - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
- ☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
- ☐ Substitution rejected - Use specified materials.
- ☐ Substitution Request received too late - Use specified materials.

Signed by: _____

Date: _____

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____



SUBSTITUTION REQUEST

(After the Bidding/Negotiating Phase)

Project: _____ Substitution Request Number: _____

From: _____
To: _____ Date: _____

A/E 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 ☐ 1-4 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 BY A/E

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 ☐ _____

SECTION 01 10 00**SUMMARY****PART 1 GENERAL****1.01 PROJECT**

- A Project Name: SECURITY UPGRADES: PHASE 3 CLASSROOM WALLS
- B Owner's Name: BEAVERTON SCHOOL DISTRICT #48J.
- C Architect's Name: HBX STUDIO ARCHITECTURE INC..
- D The Project consists of the alteration of five existing elementary schools for security and accessibility upgrades..

1.02 CONTRACT DESCRIPTION

- A Contract Type: Multiple prime contracts, each based on a Stipulated Price as described in Document 00 50 00 - Contracting Forms and Supplements.

1.03 OWNER OCCUPANCY

- A Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
- B Owner intends to occupy the Project by the date stated in the Agreement as the contract completion date.
- C Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- D Schedule the Work to accommodate Owner occupancy.

1.04 CONTRACTOR USE OF SITE AND PREMISES

- A Arrange use of site and premises to allow:
 - 1. Owner occupancy.
 - 2. Work by Others.
 - 3. Work by Owner.
- B Provide access to and from site as required by law and by Owner:
 - 1. 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.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- C Utility Outages and Shutdown:
 - 1. Limit disruption of utility services to hours the building is unoccupied.
 - 2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
 - 3. Prevent accidental disruption of utility services to other facilities.

1.05 SPECIFICATION SECTIONS APPLICABLE TO ALL CONTRACTS

- A Unless otherwise noted, all provisions of the sections listed below apply to all contracts. Specific items of work listed under individual contract descriptions constitute exceptions.
- B Section 01 20 00 - Price and Payment Procedures.
- C Section 01 31 14 - Facility Services Coordination.
- D Section 01 35 53 - Security Procedures.
- E Section 01 50 00 - Temporary Facilities and Controls.
- F Section 01 60 00 - Product Requirements.
- G Section 01 70 00 - Execution and Closeout Requirements.
- H Section 01 78 00 - Closeout Submittals.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION - NOT USED****END OF SECTION 01 10 00**

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**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.

1.02 SCHEDULE OF VALUES

- A Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- B Forms filled out by hand will not be accepted.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

- A Payment Period: Submit at intervals stipulated in the Agreement.
- B Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- C Forms filled out by hand will not be accepted.
- D Execute certification by signature of authorized officer.
- E Submit one electronic and three hard-copies of each Application for Payment.

END OF SECTION 01 20 00

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**SECTION 01 25 00
SUBSTITUTION PROCEDURES**

PART 1 GENERAL**1.01 REFERENCE STANDARDS**

- A CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage) Current Edition.
- B CSI/CSC Form 13.1A - Substitution Request (After the Bidding/Negotiating Phase) Current Edition.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION****3.01 GENERAL REQUIREMENTS**

- A A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to 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.
- B Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
- C Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 - 1. No specific form is required. Contractor's Substitution Request documentation must include the following:
 - a. Project Information:
 - 1) Owner's, Architect's, and Contractor's names.
 - b. Substitution Request Information:
 - 1) Indication of whether the substitution is for cause or convenience.
 - 2) Issue date.
 - 3) Description of Substitution.
 - c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
 - 1) Physical characteristics.
 - 2) Warranties.
 - 3) Other salient features and requirements.
 - 4) Include, as appropriate or requested, the following types of documentation:
 - (a) Product Data:
 - (b) Samples.
 - (c) Certificates, test, reports or similar qualification data.
 - d. Impact of Substitution:
 - 1) Savings to Owner for accepting substitution.
 - 2) Change to Contract Time due to accepting substitution.
- D Limit each request to a single proposed substitution item.

3.02 RESOLUTION

- A Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B Architect will notify Contractor in writing of decision to accept or reject request.

1. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.03 ACCEPTANCE

- A Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

END OF SECTION 01 25 00

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A General administrative requirements.
- B Electronic document submittal service.
- C Preconstruction meeting.
- D Progress meetings.
- E Progress photographs.
- F Submittals for review, information, and project closeout.
- G Number of copies of submittals.
- H Requests for Interpretation (RFI) procedures.
- I Submittal procedures.

1.02 REFERENCE STANDARDS

- A AIA G716 - Request for Information 2004.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

- A Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B Make the following types of submittals to Architect:
 - 1. Requests for Interpretation (RFI).
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Design data.
 - 6. Manufacturer's instructions and field reports.
 - 7. Applications for payment and change order requests.
 - 8. Progress schedules.
 - 9. Coordination drawings.
 - 10. Correction Punch List and Final Correction Punch List for Substantial Completion.
 - 11. Closeout submittals.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION****3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE (E-BUILDER)**

- A All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, 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 Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 - 2. Contractor and Architect are required to use this service.
 - 3. It is Contractor's responsibility to submit documents in allowable format.
 - 4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service 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 electronic 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 Cost: The cost of the service will be paid by Owner.
- C Submittal Service: The selected service is:
1. E-Builder: www.e-builder.net.
- D Required Submissions:
1. Submission of shop drawings and other submittals and receiving the processed submittals
 2. Submission of Requests for Information (RFI) and receiving RFI responses from the Owner and A/E
 3. Submission of invoices and approval or rejection of same
 4. Distribution of meeting minutes
 5. Submission of as-built record drawings
 6. Submission of test results and Operation and Maintenance (O&M) manuals (electronic format)
 7. Submission of Change Orders (COs) and contract amendment and approval or rejection of same
 8. Transmission of formal letters and notices between the District and the Contractor
- E Backup: In the event of occasional operational problems with e-Builder, transmission of the above documents may be done for a temporary period of time by hand carrying, email, normal mail or express mail. Prior approval must be obtained from the District before utilizing this backup communication system and a resumption of e-Builder use is to initiate as soon as the operational problems are corrected.

3.02 PRECONSTRUCTION MEETING

- A Owner will schedule a meeting after Notice of Award.
- B Attendance Required:
1. Owner.
 2. Architect.
 3. Contractor.
- C Agenda:
1. Execution of Owner-Contractor Agreement.
 2. Submission of executed bonds and insurance certificates.
 3. Distribution of Contract Documents.
 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 5. Submission of initial Submittal schedule.
 6. Designation of personnel representing the parties to Contract and Architect.
 7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 8. Scheduling.
- D Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

- A Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.
- B Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C Attendance Required:

1. Contractor.
 2. Owner.
 3. Architect.
 4. Contractor's superintendent.
 5. Major subcontractors.
- 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. Review of RFIs log and status of responses.
 7. Maintenance of progress schedule.
 8. Corrective measures to regain projected schedules.
 9. Planned progress during succeeding work period.
 10. Maintenance of quality and work standards.
 11. Effect of proposed changes on progress schedule and coordination.
 12. Other business relating to work.
- E Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 PROGRESS PHOTOGRAPHS

- A Submit new photographs at least once a month, within 3 days after being taken.
- B Photography Type: Digital; electronic files.
- C Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.
- D In addition to periodic, recurring views, take photographs of each of the following events:
- E Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
1. Delivery Medium: via E-Builder.
 2. File Naming: Include project identification, date and time of view, and view identification.
 3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.

3.05 REQUESTS FOR INTERPRETATION (RFI)

- A Definition: A request seeking one of the following:
1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.
- C Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
1. Prepare a separate RFI for each specific item.
 2. Prepare in a format and with content acceptable to Owner.
 - a. Use AIA G716 - Request for Information .
 3. Prepare using software provided by the Electronic Document Submittal Service.

3.06 SUBMITTAL SCHEDULE

- A Submit to Architect for review a schedule for submittals in tabular format.
 - 1. Coordinate with Contractor's construction schedule and schedule of values.
 - 2. Format schedule to allow tracking of status of submittals throughout duration of construction.
 - 3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 - 4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.07 SUBMITTALS FOR REVIEW

- A When the following are specified in individual sections, submit them for review:
 - 1. Product data.
 - 2. Design data.
 - 3. Shop drawings.
 - 4. Samples for selection.
 - 5. Samples for verification.
- B Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C Samples will be reviewed 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.

3.08 SUBMITTALS FOR INFORMATION

- A When the following are specified in individual sections, submit them for information:
 - 1. Certificates.
 - 2. Test reports.
 - 3. Inspection reports.
 - 4. Manufacturer's instructions.
 - 5. Manufacturer's field reports.
 - 6. Other types indicated.
- B Submit for Architect's knowledge as contract administrator or for Owner.

3.09 SUBMITTALS FOR PROJECT CLOSEOUT

- A Submit Correction Punch List for Substantial Completion.
- B Submit Final Correction Punch List for Substantial Completion.
- C When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other types as indicated.
- D Submit for Owner's benefit during and after project completion.

3.10 NUMBER OF COPIES OF SUBMITTALS

- A Electronic 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.

3.11 SUBMITTAL PROCEDURES

- A General Requirements:
 - 1. Transmit using approved form.
 - a. Use Contractor's form, subject to prior approval by Architect.
 - 2. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 - 3. 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.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
 - 4. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - a. Upload submittals in electronic form to Electronic Document Submittal Service website.
 - 5. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 - 6. Provide space for Contractor and Architect review stamps.
 - 7. When revised for resubmission, identify all changes made since previous submission.
 - 8. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
 - 9. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
 - 10. Submittals not requested will not be recognized or processed.
- B Shop Drawing Procedures:
 - 1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 - 2. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- C Samples Procedures:
 - 1. Transmit related items together as single package.
 - 2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
 - 3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.

3.12 SUBMITTAL REVIEW

- A Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
 - 1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
- D Architect's and consultants' actions on items submitted for review:

1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Approved", or language with same legal meaning.
 - b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
 - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
 - c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
 - 1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
 2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit".
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.
 - b. "Rejected".
 - 1) Submit item complying with requirements of Contract Documents.
- E Architect's and consultants' actions on items submitted for information:
1. Items for which no action was taken:
 - a. "Received" - to notify the Contractor that the submittal has been received for record only.
 2. Items for which action was taken:
 - a. "Reviewed" - no further action is required from Contractor.

END OF SECTION 01 30 00

SECTION 01 35 53
SECURITY PROCEDURES

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Security measures including entry control, personnel identification, and background screening.

1.02 RELATED REQUIREMENTS**1.03 ENTRY CONTROL**

- A Restrict entrance of persons and vehicles into Project site and existing facilities.
- B Allow entrance only to authorized persons with proper identification.

1.04 PERSONNEL IDENTIFICATION

- A Provide identification badge to each person authorized, including sub-contractors to enter premises.
- B Badge To Include:
 - 1. Individual's full name (no nicknames)
 - 2. Individual's company affiliation
 - 3. Recent photograph of the individual; taken within the last four (4) years
- C Maintain a list of accredited persons, submit copy to Owner on request.
- D Require return of badges at expiration of their employment on the Work.

1.05 BACKGROUND SCREENING

- A All personnel under the employment of the Contractor and its Subcontractors that spend time at the project site, must provide a formal background screening at the cost of the Contractor and pass that screening review before being allowed on the work site.
 - 1. No Pass Result - Worker is not allowed on Project Site
- B Screening Criteria: Commitment of any crime as listed in ORS 342.143, most recent version
- C Background Screening Company Qualification
 - 1. Minimum five (5) years screening experience specifically for construction industry clients
 - 2. Minimum fifteen (15) employees
 - 3. Provide access to an internet based screening management software system which has a feature to allow access by the District to view the pass-no pass result for each screened Contractor/Subcontractor working on a District project
 - 4. Accredited by the National Association of Professional Background Screeners (NAPBS)

1.06 CREDENTIALING

- A List of Approved Employees - The Contractor is to send a list of all employees and subcontractors who have passed the background check to the District

1.07 CONSTRUCTION/MAINTENANCE BUILDING SECURITY RULES

- A The Contractor shall enforce strict discipline and good order among the Contractor's employees, Subcontractors, and other persons carrying out the contract on District property. The District may require that the Contractor immediately remove from the project site and District property any employee or other person carrying out the contract that the District considers objectionable.
- B The Contractor shall have a responsible party such as a superintendent, foreman, or supervisor on site during any work being performed by either their own forces or that of their subcontractors.
- C The superintendent shall check in with the responsible District Personnel upon arrival and advise when all work is complete, contract personnel have left, and the area is secure.
- D The Contractor's superintendent shall be responsible for security in areas where work is being performed as well as ingress and egress to that area.
- E Smoking and any use of tobacco products, including vaping, is not allowed within 50 feet of the campus property. Works will be removed from the site for violations.

- F Use of alcohol is not allowed on campus property. Visibly intoxicated workers will be removed from site for violations.
- G Illegal drugs, including marijuana, is forbidden on school district property. Possession of illegal drugs, or marijuana, is considered a violation.
- H Firearms are not allowed on campus property. Law enforcement will be contacted if any contractor personnel are in possession of a firearm while on site.
- I Abusive, inappropriate, and/or foul language is strictly prohibited on active campus projects. Employees who abuse this rule will be asked to leave the project site.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 35 53

**SECTION 01 40 00
QUALITY REQUIREMENTS**

PART 1 GENERAL**1.01 RELATED REQUIREMENTS**

- A **ATTACHMENT A** - Asbestos Abatement Contractor Bid Document and Specifications

1.02 TESTING AND INSPECTION AGENCIES AND SERVICES

- A Owner will employ and pay for services of an independent testing agency to perform other specified testing.
- B Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

1.03 CLOSEOUT STATEMENTS

- A The Contractor shall provide the below statements as part of project closeout certifying that materials and construction meet the District's hazardous free requirements
1. Asbestos: No asbestos containing materials may be used in the construction or remodel of any facilities located within the Beaverton School District.
 2. Lead: Water testing within areas of work meet district testing requirements for lead free condition

1.04 ASBESTOS ABATEMENT CONSULTANT (AAC)

- A The Beaverton School District retains an Asbestos Abatement Consultant to test presumed asbestos containing material (PACM) and to oversee all asbestos abatement work that takes place within their facilities. This consultant is to be an integral part of the construction process.
- B The Contractor will retain the following responsibilities:
1. Immediately reporting to the District and its Asbestos Consultant the finding of suspected asbestos material
 2. Following of any rapid response procedures to isolate District staff, students, facility, visitors, and Contractor staff from the suspected material, while maintaining continued progress on the remainder of the project work
 3. Perform abatement work, include base scope as reference in the hazardous material report (KINNAMAN) as an addendum to this specification.
 4. Engage and coordinate with the District's AAC during all abatement and remediation work performed on site.
 5. Resuming full scale work activities on the project as soon as the remediation is complete
- C The District's Asbestos Abatement Consultant (AAC) will retain the following responsibilities
1. Take and secure samples of suspected asbestos containing material
 2. Sending a sample of the suspected material to a qualified testing laboratory, receiving test results, and informing the District and their Asbestos Consultant
 3. If the material is confirmed to contain asbestos, generate recommendations for Owner's review and then implementing asbestos remediation

1.05 TESTING AND INSPECTION OF PLUMBING PIPES AND FIXTURES

- A The Owner's Representative and BSD's Maintenance Administrator shall be notified at all under floor, framing, and top out inspections, so that piping routes, valves, connections, and any other pertinent plumbing applications can be verified and documented.
- B New or remodeled potable plumbing systems shall be tested for lead by a BSD approved third party environmental consultant. If test results detect more than 1 ppb of lead, contractor shall be responsible to provide the mitigation and retesting until required results are achieved or flush draw tests showing the source of lead is outside the scope of the project.

PART 3 EXECUTION**2.01 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.

2.02 DEFECT ASSESSMENT

- A Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION 01 40 00

**SECTION 01 41 00
REGULATORY REQUIREMENTS**

PART 1 GENERAL**1.01 SUMMARY OF REFERENCE STANDARDS**

- A Regulatory requirements applicable to this project are the following:
- B 28 CFR 35 - Nondiscrimination on the Basis of Disability in State and Local Government Services; Final Rule; Department of Justice current edition.
- C 28 CFR 36 - Nondiscrimination by Public Accommodations and in Commercial Facilities; Final Rule; Department of Justice current edition.
- D 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
- E 49 CFR 37 - Transportation Services for Individuals with Disabilities (ADA) current edition.
- F ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- G FED-STD-795 - Uniform Federal Accessibility Standards (UFAS) 1988.
- H 29 CFR 1910 - Occupational Safety and Health Standards Current Edition.
- I ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- J NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.02 RELATED REQUIREMENTS

- A Section 01 40 00 - Quality Requirements.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION - NOT USED****END OF SECTION 01 41 00**

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SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Temporary utilities.
- B Temporary sanitary facilities.
- C Temporary Controls: Barriers, enclosures, and fencing.
- D Security requirements.
- E Vehicular access and parking.
- F Waste removal facilities and services.

1.02 TEMPORARY UTILITIES

- A Owner will provide the following:
 - 1. Electrical power and metering, consisting of connection to existing facilities.
 - 2. Water supply, consisting of connection to existing facilities.
- B Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes above and beyond those within the existing facilities.

1.03 TEMPORARY SANITARY FACILITIES

- A Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B Use of existing facilities at project site is not permitted
- C Maintain daily in clean and sanitary condition.
- D At end of construction, return facilities to same or better condition as originally found.

1.04 PROTECTION OF EXISTING CONDITIONS

- A General Contractor to provide protection for all existing conditions to remain in place, including temporary barriers, sheeting or other means and methods to preserve existing built-in elements and fixtures
- B Signage and tape may be provided to direct workers away from areas separate from active work locations, however, this does not alleviate the General Contractor's responsibility to protect all existing conditions within each school.

1.05 BARRIERS

- A Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.06 FENCING

- A Construction: Commercial grade chain link fence.
- B Provide 6 foot (1.8 m) high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.07 EXTERIOR ENCLOSURES

- A Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.08 SECURITY

- A Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
- B Coordinate with Owner's security program.

1.09 VEHICULAR ACCESS AND PARKING

- A Coordinate access and haul routes with governing authorities and Owner.
- B Provide and maintain access to fire hydrants, free of obstructions.
- C Provide means of removing mud from vehicle wheels before entering streets.
- D Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.10 WASTE REMOVAL

- A Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B Provide containers with lids. Remove trash from site periodically.
- C If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.11 FIELD OFFICES

- A Owner Provided: Owner to provide temporary interior space for field office including power, internet within an existing classroom or office at each project location.
- B Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C At termination of project, leave the temporary field office in better condition than when found

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION - NOT USED****END OF SECTION 01 50 00**

**SECTION 01 60 00
PRODUCT REQUIREMENTS**

PART 1 GENERAL**1.01 RELATED REQUIREMENTS**

- A Section 01 25 00 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- B Section 01 74 19 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.02 SUBMITTALS

- A 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.
- B 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.
- C 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.

PART 2 PRODUCTS**2.01 NEW PRODUCTS**

- A Provide new products unless specifically required or permitted by Contract Documents.
- B Use of products having any of the following characteristics is not permitted:
- C Where other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions, as defined in Section 01 61 16.
 - 2. If wet-applied, have lower VOC content, as defined in Section 01 61 16.

2.02 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 One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

PART 3 EXECUTION**3.01 SUBSTITUTION LIMITATIONS**

- A See Section 01 25 00 - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

- A Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D Transport and handle products in accordance with manufacturer's instructions.
- E Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

- H Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 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. See Section 01 74 19.
- B Store and protect products in accordance with manufacturers' instructions.
- C Store with seals and labels intact and legible.
- D Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E For exterior storage of fabricated products, place on sloped supports above ground.
- F Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- G Comply with manufacturer's warranty conditions, if any.
- H Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I Prevent contact with material that may cause corrosion, discoloration, or staining.
- J Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- K 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 01 60 00

SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Examination, preparation, and general installation procedures.
- B Cutting and patching.
- C Cleaning and protection.
- D Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

1.02 RELATED REQUIREMENTS

- A Section 01 30 00 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
- B Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
- C Section 07 84 00 - Firestopping.

1.03 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**2.01 PATCHING MATERIALS**

- A New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

PART 3 EXECUTION**3.01 EXAMINATION**

- A Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C Examine and verify specific conditions described in individual specification sections.
- D Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

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

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, 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.

3.04 GENERAL INSTALLATION REQUIREMENTS

- A Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 CUTTING AND PATCHING

- A Whenever possible, execute the work by methods that avoid cutting or patching.
- B Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-complying work.
- C Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- D Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- E Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- F Restore work with new products in accordance with requirements of Contract Documents.
- G Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.
- I Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. 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.

3.06 PROGRESS CLEANING

- A Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.07 PROTECTION OF INSTALLED WORK

- A Protect installed work from damage by construction operations.
- B Provide special protection where specified in individual specification sections.
- C Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F 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.
- G Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.08 ADJUSTING

- A Adjust operating products and equipment to ensure smooth and unhindered operation.

3.09 FINAL CLEANING

- A Use cleaning materials that are nonhazardous.
- B Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- D Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- E Clean filters of operating equipment.
- F Clean site; sweep paved areas, rake clean landscaped surfaces.
- G Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.10 CLOSEOUT PROCEDURES

- A Make submittals that are required by governing or other authorities.
- B Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion

inspection.

- E Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

END OF SECTION 01 70 00

SECTION 01 74 19**CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL****PART 1 GENERAL****1.01 WASTE MANAGEMENT REQUIREMENTS**

- A Owner requires that this project generate the least amount of trash and waste possible.
- B Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
- E Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
- F Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 DEFINITIONS

- A Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I Return: To give back reusable items or unused products to vendors for credit.
- J Reuse: To reuse a construction waste material in some manner on the project site.
- K Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.03 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
 - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
 - 2. Submit Report on a form acceptable to Owner.
 - 3. Landfill Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project disposed of in landfills.
 - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 4. Incinerator Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project delivered to incinerators.
 - c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 5. Recycled and Salvaged Materials: Include the following information for each:
 - a. Identification of material, including those retrieved by installer for use on other projects.
 - b. Amount, in tons or cubic yards (cubic meters), date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
 - 6. Material Reused on Project: Include the following information for each:
 - a. Identification of material and how it was used in the project.
 - b. Amount, in tons or cubic yards (cubic meters).
 - c. Include weight tickets as evidence of quantity.
 - 7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 3 EXECUTION**2.01 WASTE MANAGEMENT PROCEDURES**

- A See Section 01 30 00 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B See Section 01 50 00 for additional requirements related to trash/waste collection and removal facilities and services.
- C See Section 01 60 00 for waste prevention requirements related to delivery, storage, and handling.
- D See Section 01 70 00 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

2.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- C Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D Meetings: Discuss trash/waste management goals and issues at project meetings.
 - 1. Prebid meeting.
 - 2. Preconstruction meeting.
 - 3. Regular job-site meetings.
- E Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
 - 1. Provide containers as required.
 - 2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
 - 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION 01 74 19

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**SECTION 01 78 00
CLOSEOUT SUBMITTALS**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Project record documents.
- B Operation and maintenance data.
- 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 70 00 - Execution and Closeout Requirements: 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 Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B Operation and Maintenance Data:
 - 1. Submit all data via E-Builder
 - 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. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit final documentation electronically through the Electronic Submittal Service
- C Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 3 EXECUTION**2.01 PROJECT RECORD DOCUMENTS**

- A Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Addenda.
 - 3. Change Orders and other modifications to the Contract.
- B Ensure entries are complete and accurate, enabling future reference by Owner.
- C Store record documents separate from documents used for construction.
- D Record information concurrent with construction progress.
- E Record Drawings: Legibly mark each item to record actual construction including:
 - 1. Field changes of dimension and detail.
 - 2. Details not on original Contract drawings.

2.02 OPERATION AND MAINTENANCE DATA

- A Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- B 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.

- C Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

2.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A For Each Product, Applied Material, and Finish:
 - 1. Product data, with catalog number, size, composition, and color and texture designations.
- B Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C 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.

2.04 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 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.
- D Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- E Include manufacturer's printed operation and maintenance instructions.
- F Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

2.05 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 Format: Provide within digital PDF format, uploaded to E-Builder. Provide page labels and bookmarks for individual sections and content within bound PDF files.
- C Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- D 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.

2.06 WARRANTIES AND BONDS

- A 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 Date of Substantial completion is determined.
- B Verify that documents are in proper form, contain full information, and are notarized.
- C Co-execute submittals when required.
- D Retain warranties and bonds until time specified for submittal.

END OF SECTION 01 78 00

SECTION 01 91 13
GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL**1.01 SUMMARY**

- A Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
 - 1. Verify that the work is installed in accordance with Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
 - 2. Verify and document that functional performance is in accordance with Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
 - 3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
 - 4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.
- B The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.

1.02 RELATED REQUIREMENTS

- A Section 01 78 00 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.

PART 2 PRODUCTS**2.01 TEST EQUIPMENT**

- A Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
 - 1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F (0.3 degree C) and resolution of plus/minus 0.1 degree F (0.05 degree C).
 - 2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
 - 3. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.
- C Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.
- D Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
 - 1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

PART 3 EXECUTION**3.01 COMMISSIONING PLAN**

- A Commissioning Authority has prepared the Commissioning Plan.

1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
 2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.
- B Contractor is responsible for compliance with the Commissioning Plan.
- C Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.
- D Commissioning Schedule:
1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
 2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
 3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
 4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.02 STARTUP PLANS AND REPORTS

- A Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.
- B Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.
- C Submit directly to the Commissioning Authority.

3.03 PREFUNCTIONAL CHECKLISTS

- A A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
1. No sampling of identical or near-identical items is allowed.
 2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
 3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
 - a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
 - b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
 - c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
 - d. Serial number of installed unit.
 - e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer's start-up checklist items and minor testing.
 - f. Sensor and actuator calibration information.
- B Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
 2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable

- Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
 4. If any Checklist line item is not relevant, record reasons on the form.
 5. Contractor may independently perform startup inspections and/or tests, at Contractor's option.
 6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
 7. Submit completed Checklists to Commissioning Authority within two days of completion.
- C Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in Contract Documents.
 2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
 3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in Contract Documents or not.
 4. When asked to review the proposed Checklists, do so in a timely manner.
- D Commissioning Authority Witnessing: Required for:
1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
 2. A sampling of non-primary equipment, as allowed by the commissioning plan.
- E Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.04 FUNCTIONAL TESTS

- A A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.
- B Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.
- C Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.
- D Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with Contract Documents or does not perform properly.
 2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
 3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all

- items.
- 4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
- 5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.
- E Functional Test Procedures:
 - 1. Some test procedures are included in Contract Documents; where Functional Test procedures are not included in Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
 - 2. Examples of Functional Testing:
 - a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
 - b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
 - c. Systems are run through all the HVAC control system's sequences of operation and components are verified to be responding as the sequence's state.
 - d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.
- F Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

3.05 SENSOR AND ACTUATOR CALIBRATION

- A Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gauges, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
- B Calibrate using the methods described below; alternate methods may be used, if approved by Commissioning Authority and Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.
- C All Sensors:
 - 1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
 - 2. Verify that sensors with shielded cable are grounded only at one end.
 - 3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F (0.1 degree C) of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
 - 4. Tolerances for critical applications may be tighter.
- D Sensors Without Transmitters - Standard Application:
 - 1. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.

2. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
 3. If not, install offset, calibrate or replace sensor.
- E Sensors With Transmitters - Standard Application.
1. Disconnect sensor.
 2. Connect a signal generator in place of sensor.
 3. Connect ammeter in series between transmitter and building automation system control panel.
 4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
 5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
 6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
 7. Record all values and recalibrate controller as necessary to comply with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
 8. Reconnect sensor.
 9. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
 10. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
 11. If not, replace sensor and repeat.
 12. For pressure sensors, perform a similar process with a suitable signal generator.
- F Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
 2. Pressure, Air, Water, Gas: 3 percent of design.
 3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F (0.2 degree C).
 4. Relative Humidity: 4 percent of design.
 5. Barometric Pressure: 0.1 inch of Hg (340 Pa).
 6. Flow Rate, Air: 10 percent of design.
 7. Flow Rate, Water: 4 percent of design.
 8. AHU Wet Bulb and Dew Point: 2.0 degrees F (1.1 degrees C).
- G Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.
- H Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 2. Set pump/fan to normal operating mode.
 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 4. Command valve/damper to open; verify position is full open and adjust output signal as required.
 5. Command valve/damper to a few intermediate positions.
 6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- I Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
 2. Use an ultra-sonic flow meter to detect flow or leakage.

3.06 TEST PROCEDURES - GENERAL

- A Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
- B Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.
- C Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
 - 1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
 - 2. Sampling is not allowed for:
 - a. Major equipment.
 - b. Life-safety-critical equipment.
 - c. Prefunctional Checklist execution.
 - 3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
 - 4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
 - 5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
 - 6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
 - 7. If YY percent of the units in the second sample fail, test all remaining identical units.
 - 8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.
- D Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- E Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.
- F Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.
- G Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.
- H Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.
- I Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
 - 1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority's request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
 - 2. Other points will be monitored by the Commissioning Authority using dataloggers.

3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
5. Graphical output is desirable and is required for all output if the system can produce it.
6. Monitoring may be used to augment manual testing.

3.07 OPERATION AND MAINTENANCE MANUALS

- A See Section 01 78 00 - Closeout Submittals for additional requirements.
- B Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D Commissioning Authority will add commissioning records to manuals after submission to Owner.

END OF SECTION 01 91 13

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**SECTION 02 41 00
DEMOLITION**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

- A Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- B Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- C Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

PART 3 EXECUTION**2.01 GENERAL PROCEDURES AND PROJECT CONDITIONS**

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

2.02 EXISTING UTILITIES

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

2.03 SELECTIVE DEMOLITION FOR ALTERATIONS

- A Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
- C Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- D Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

2.04 DEBRIS AND WASTE REMOVAL

- A Remove debris, junk, and trash from site.
- B Leave site in clean condition, ready for subsequent work.
- C Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 02 41 00

**SECTION 06 10 00
ROUGH CARPENTRY**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Miscellaneous framing and sheathing.
- B Concealed wood blocking, nailers, and supports.

1.02 RELATED REQUIREMENTS

- A Section 09 21 16: Gypsum Board Assemblies - Blocking for wall mounted equipment & furnishings
- B Section 09 22 16: Non-Structural Metal Framing - Blocking at top and bottom of wall attachments

1.03 REFERENCE STANDARDS

- A ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- B PS 20 - American Softwood Lumber Standard 2021.

PART 2 PRODUCTS**2.01 GENERAL REQUIREMENTS**

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

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A Sizes: Nominal sizes as indicated on drawings, S4S.
- B Moisture Content: S-dry or MC19.
- C Stud Framing (2 by 2 through 2 by 6 (50 by 50 mm through 50 by 150 mm)):
 - 1. Species: Douglas Fir-Larch.
 - 2. Grade: No. 2.
- D Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 ACCESSORIES

- A Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

PART 3 EXECUTION**3.01 INSTALLATION - GENERAL**

- A Select material sizes to minimize waste.
- B Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.02 BLOCKING, NAILERS, AND SUPPORTS

- A Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

C Provide the following specific nonstructural framing and blocking:

1. Cabinets and shelf supports.
2. Wall brackets.
3. Handrails.
4. Grab bars.
5. Towel and bath accessories.
6. Wall-mounted door stops.
7. Chalkboards and marker boards.
8. Wall paneling and trim.
9. Joints of rigid wall coverings that occur between studs.

3.03 CLEANING

A Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.

1. Comply with applicable regulations.
2. Do not burn scrap on project site.
3. Do not burn scraps that have been pressure treated.
4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.

B Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 06 10 00

**SECTION 06 20 00
FINISH CARPENTRY**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Finish carpentry items.

1.02 REFERENCE STANDARDS

- A AWI (QCP) - Quality Certification Program Current Edition.
- B AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
- C AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards 2021, with Errata.

1.03 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Product Data:
- C Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
 - 2. Include certification program label.
- D Samples: Submit two samples of wood trim 4 inch ([] mm) long.
- E Samples: Submit two samples of Cap, Base, and Column Shaft, one-quarter full size, illustrating one-quarter finish, construction, and [].

1.04 QUALITY ASSURANCE

- A Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project within the past 5 years with value of woodwork within 20 percent of cost of woodwork for this project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B Quality Certification:
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
 - 2. Provide labels or certificates indicating that work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Provide designated labels on installed products as required by certification program.
 - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A Protect from moisture damage.
- B Handle materials and products to prevent damage to edges, ends, or surfaces.

PART 2 PRODUCTS**2.01 FINISH CARPENTRY ITEMS**

- A Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B Interior Woodwork Items:
 - 1. Moldings, Bases, Casings, and Miscellaneous Trim: Clear white pine; prepare for paint finish.
 - 2. Door, Glazed Light, and Pocket Door Frames: White birch; prepare for paint finish.
 - 3. Stairs, Balustrades, and Handrails: Clear fir; prepare for stained finish.

2.02 LUMBER MATERIALS

- A Softwood Lumber: existing species, [] sawn, maximum moisture content of 6 percent; with vertical grain, of quality suitable for transparent finish.
- B Hardwood Lumber: existing species, [] sawn, maximum moisture content of 6 percent ; with vertical grain , of quality suitable for transparent finish.

2.03 SITE FINISHING MATERIALS

- A Stain, Shellac, Varnish, and Finishing Materials: Comply with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

2.04 FABRICATION

- A Shop assemble work for delivery to site, permitting passage through building openings.
- B When necessary to cut and fit on site, provide materials with ample allowance for cutting.
Provide trim for scribing and site cutting.

PART 3 EXECUTION**3.01 EXAMINATION**

- A Verify adequacy of backing and support framing.

3.02 INSTALLATION

- A Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B Set and secure materials and components in place, plumb and level.
- C Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (0.79 mm).
Do not use additional overlay trim to conceal larger gaps.

3.03 TOLERANCES

- A Maximum Variation from True Position: 1/16 inch (1.6 mm).
- B Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.79 mm).

END OF SECTION 06 20 00

SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Specially fabricated cabinet units.
- B Hardware.

1.02 RELATED REQUIREMENTS

- A Section 12 36 00 - Countertops.

1.03 REFERENCE STANDARDS

- A AWI (QCP) - Quality Certification Program Current Edition.
- B AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
- C AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards 2021, with Errata.
- D BHMA A156.9 - Cabinet Hardware 2020.
- E HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood 2020.

1.04 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
- C Product Data: Provide data for hardware accessories.
- D Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches (300 mm) square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.

1.05 QUALITY ASSURANCE

- A Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B Quality Certification:
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
 - 2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Provide designated labels on installed products as required by certification program.
 - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
 - 6. Replace, repair, or rework all work for which certification is refused.

1.06 DELIVERY, STORAGE, AND HANDLING

- A Protect units from moisture damage.

1.07 FIELD CONDITIONS

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

PART 2 PRODUCTS**2.01 CABINETS**

- A Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B Wood Veneer Faced Cabinet:

1. Exposed Surfaces: HPVA HP-1 Grade A, Ash, plain sliced, random-matched.
2. Semi-Exposed Surfaces: HPVA HP-1 Grade B, Ash, plain sliced, random-matched.
3. Concealed Surfaces: Manufacturer's option.

C Plastic Laminate Faced Cabinets: Custom grade.

2.02 WOOD-BASED COMPONENTS

- A Wood fabricated from old growth timber is not permitted.
- B Hardwood Edgebanding: Use solid hardwood edgebanding matching species, color, grain, and grade for exposed portions of cabinetry.

2.03 LAMINATE MATERIALS

- A Manufacturers:
1. Arborite; ColorEdge: www.arborite.com/#sle.
 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 COUNTERTOPS

- A Countertops: See Section 12 36 00.

2.05 ACCESSORIES

- A Adhesive: Type recommended by fabricator to suit application.
- B Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
1. Color: As indicated on drawings.
- C Vinyl Countertop Edge: PVC anchor type tee-molding edging in width to match thickness of countertop, color as indicated, used at locations as indicated.
- D Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- E Concealed Joint Fasteners: Threaded steel.
- F Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

2.06 HARDWARE

- A Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B Metal Z-Shaped Wall Cabinet Support Clips: Paired, cleated, structural anchorage components applied to back of cabinets and walls for wall cabinet mounting.
- C Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome or satin chrome finish, for nominal 1 inch (25 mm) spacing adjustments.
- D Fixed Specialty Shelf Supports:
1. Material: Steel.
 2. Manufacturer's standard, factory-applied, textured powder coat.
 3. Color: Black.
- E Fixed Specialty Workstation and Countertop Brackets:
1. Material: Steel.
 2. Finish: Manufacturer's standard, factory-applied powder coat.
 3. Color: Black.
- F Drawer and Door Pulls: Per Architectural Drawings
- G Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
- H Drawer Slides:
1. Type: Extension types as indicated.
 2. Static Load Capacity: Commercial grade.
 3. Mounting: Side mounted.
 4. Stops: Integral type.
 5. Features: Provide self closing/stay closed type.

- I Hinges: European style concealed self-closing type, steel with nickel-plated finish.
- J Soft Close Adapter: Concealed, frame-mounted, screw-adjustable damper; steel with polished finish.

2.07 FABRICATION

- A Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs. (Locate counter butt joints minimum 600 mm from sink cut-outs.)
 - 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 - 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- E Matching Wood Grain: Comply with requirements of quality standard for specified Grade and as follows:
 - 1. Provide balance matched panels at each elevation.
 - 2. Provide sequence matching across each elevation.
 - 3. Carry figure of cabinet fronts to toe kicks.
- F Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches (400 mm) on center.
- G Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

2.08 SHOP FINISHING

- A Sand work smooth and set exposed nails and screws.
- B For opaque finishes, apply wood filler in exposed nail and screw indentations and sand smooth.
- C On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.
- D Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C Use fixture attachments in concealed locations for wall mounted components.
- D Use concealed joint fasteners to align and secure adjoining cabinet units.
- E Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.
- F Secure cabinets to floor using appropriate angles and anchorages.
- G Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

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

3.04 CLEANING

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

END OF SECTION 06 41 00

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

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

1.02 RELATED REQUIREMENTS

- A Section 09 21 16 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- B Section 09 22 16 - Non-Structural Metal Framing: Sealing between framing and adjacent construction in acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS

- A ASTM C834 - Standard Specification for Latex Sealants 2017.
- B ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications 2022.
- C ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- D ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- E ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2022.
- F SCAQMD 1168 - Adhesive and Sealant Applications 1989, with Amendment (2017).

1.04 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
- C Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
 - 1. Dow: www.dow.com/#sle.
 - 2. Hilti, Inc: www.us.hilti.com/#sle.
 - 3. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 JOINT SEALANT APPLICATIONS

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

- b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
 - c. Other joints indicated below.
- B Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
- C Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
 - 1. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
- D Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.03 JOINT SEALANTS - GENERAL

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

2.04 NONSAG JOINT SEALANTS

- A Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 50 percent, minimum.
 - 2. Non-Staining to Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
 - 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
- B Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 50 percent, minimum.
- C Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.

2.05 ACCESSORIES

- A Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
- B Overlay Extrusion for Glazing System Joint Protection: Rubber profiled extrusions placed over joints in glazing system and provided with watertight seal.
 - 1. Profile: As required to match existing metal glazing cap requirements.
 - 2. Color: As required to match existing conditions.
- C Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- D Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- E Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

- A Verify that joints are ready to receive work.
- B Verify that backing materials are compatible with sealants.
- C Verify that backer rods are of the correct size.

3.02 PREPARATION

- A Remove loose materials and foreign matter that could impair adhesion of sealant.
- B Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

- A Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B Perform installation in accordance with ASTM C1193.
- C Perform acoustical sealant application work in accordance with ASTM C919.
- D Install bond breaker backing tape where backer rod cannot be used.
- E Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- F Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- G Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION 07 92 00

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**SECTION 08 12 13
HOLLOW METAL FRAMES**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Non-fire-rated hollow metal frames for non-hollow metal doors.

1.02 RELATED REQUIREMENTS

- A Section 08 14 16 - Flush Wood Doors: Non-hollow metal door for hollow metal frames.
- B Section 08 71 00 - Door Hardware: Hardware, silencers, and weatherstripping.
- C Section 08 80 00 - Glazing: Glazed borrowed lites.
- D Section 09 91 23 - Interior Painting: Field painting.

1.03 REFERENCE STANDARDS

- A ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2018.
- C ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames 2020.
- D ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.
- E ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2020.
- F ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- G ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.
- H ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
- I BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames 2016.
- J ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- K NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.
- L NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.
- M NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames 2017.
- N NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames 2014.

1.04 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
- D Installer's Qualification Statement.
- E Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A Store in accordance with applicable requirements and in compliance with standards and/or custom guidelines as indicated.

- B Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

1.07 WARRANTY

- A See Section 01 78 00-Closeout Submittals for additional warranty requirements.
- B Door Frames : Provide manufacturer's warranty for ten years

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A Hollow Metal Frames with Integral Casings:
 - 1. Curries, an Assa Abloy Group company; []: www.assaabloydss.com/#sle.
 - a. Product: Designed to use with Curries 747 T
 - b. Substitutions: No substitutions allowed

2.02 PERFORMANCE REQUIREMENTS

- A Door Frame Type: Provide hollow metal door frames with integral casings.
 - 1. Interior Doors: Use frames with integral casings.
- B Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
- C Accessibility: Comply with ICC A117.1 and ADA Standards.
- D Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior frame that is also indicated as being sound-rated must comply with the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.
- E Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830, NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

2.03 HOLLOW METAL DOOR FRAMES WITH INTEGRAL CASINGS

- A Frame Finish: Factory primed and field finished.
- B Type A , Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Frame Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
 - 2. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inches (152 mm) above floor at 45 degree angle.

2.04 FINISHES

- A Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.05 ACCESSORIES

- A Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- B Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.

- B Coordinate frame anchor placement with wall construction.
- C Install door hardware as specified in Section 08 71 00.
 - 1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.

END OF SECTION 08 12 13

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SECTION 08 14 16
FLUSH WOOD DOORS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Flush wood doors; flush and flush glazed configuration; fire-rated, non-rated, acoustical, special function, and [_____].

1.02 RELATED REQUIREMENTS

- A Section 08 12 13 - Hollow Metal Frames.
- B Section 08 71 00 - Door Hardware.
- C Section 08 80 00 - Glazing.
- D Section 09 93 00 - Staining and Transparent Finishing: Field finishing of doors.

1.03 REFERENCE STANDARDS

- A ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- B ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- C ASTM E413 - Classification for Rating Sound Insulation 2022.
- D AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
- E AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards 2021, with Errata.

1.04 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D Test Reports: Show compliance with specified requirements for the following:
 - 1. Sound-retardant doors and frames; sealed panel tests are not acceptable.
- E Installer's qualification statement.
- F Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 WARRANTY

- A See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B Interior Doors: Provide manufacturer's warranty for three years on doors, 10 years on door glass.
- C Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A Wood Veneer Faced Doors:
 - 1. Oregon Door; Architectural Series: www.oregondoor.com/#sle.
 - 2. American Direct, www.americandirectco.com.

3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DOORS AND PANELS

- A Doors: See drawings for locations and additional requirements.
 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
 1. Provide solid core doors at each location.
 2. Sound-Rated Doors: Minimum STC of 33, calculated in accordance with ASTM E413, tested in accordance with ASTM E90.
 3. Wood veneer facing for field transparent finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

- A Sound-Rated Doors: Equivalent to type, with particleboard core (PC) construction as required to achieve STC rating specified; plies and faces as indicated above.

2.04 DOOR FACINGS

- A Veneer Facing for Transparent Finish: Red oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
 1. Vertical Edges: Any option allowed by quality standard for grade.
 2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet (3 m) of each other when doors are closed.

2.05 DOOR CONSTRUCTION

- A Fabricate doors in accordance with door quality standard specified.
- B Cores Constructed with stiles and rails:
 1. Provide solid blocks at lock edge for hardware reinforcement.
- C Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- D Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

- A Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 1. Transparent:
 - a. System - 1, Lacquer, Nitrocellulose.
 - b. Stain: Match Existing Stain and finish as existing doors
 - c. Sheen: Flat.

2.07 ACCESSORIES

- A Hollow Metal Door Frames: See Section 08 12 13.
- B Glazed Openings:
 1. Heat-Strengthened and Fully Tempered Glass: ASTM C1048.
 2. Glazing: Single vision units, 1/4 inch (6.4 mm) thick glass.
 3. Tint: Clear.
- C Glazing Stops: Rolled steel channel shape, butted corners; prepared for countersink style tamper proof screws.
- D Door Hardware: See Section 08 71 00.

PART 3 EXECUTION**3.01 EXAMINATION**

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

3.02 INSTALLATION

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

3.03 TOLERANCES

- A Comply with specified quality standard for fit and clearance tolerances.
- B Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A Adjust doors for smooth and balanced door movement.
- B Adjust closers for full closure.

END OF SECTION 08 14 16

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SECTION 08 43 13
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL**1.01 SECTION INCLUDES (KINNAMAN ELEMENTARY ONLY)**

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

1.02 REFERENCE STANDARDS

- A AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site 2015.
- B AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
- C ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- D ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.
- E ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2019.
- F ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014 (Reapproved 2021).

1.03 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- C Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
- D Samples: Submit two samples 4" x 4" inches (____ x ____ mm) in size illustrating finished aluminum surface, glass, infill panels, glazing materials.
- E Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

1.04 QUALITY ASSURANCE

- A Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in OREGON.
- B Installer Qualifications: Company specializing in performing work of type specified and with at least two years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

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

1.06 WARRANTY

- A See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS**2.01 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING**

- A Front-Set Style, Wind-Borne-Debris Resistance Tested:
 - 1. Basis of Design: Kawner 451 T.

2.02 BASIS OF DESIGN -- SWINGING DOORS

- A Wide Stile, Insulating Glazing, Thermally-Broken:
 - 1. Basis of Design: Kawneer 500 Wide Stile.
 - a. Center Rail: Include center rail to fully conceal panic hardware
 - b. Kickplate: 10" x 2" LDW
 - 2. Thickness: 1-3/4 inches (43 mm).
 - 3. Color: Match storefront system

2.03 ALUMINUM-FRAMED STOREFRONT

- A Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Finish: Superior performing organic coatings.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 - 2. Finish Color: Color match existing window mullion color.
 - 3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - 4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 - 5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 - 6. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 - 7. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 - 8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
- B Performance Requirements
 - 1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
 - 2. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure difference.

2.04 COMPONENTS

- A Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 - 1. Glazing Stops: Flush.

2.05 MATERIALS

- A Extruded Aluminum: ASTM B221 (ASTM B221M).
- B Fasteners: Stainless steel.
- C Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
 - 1. Type: Ethylene Propylene Diene Monomer (EPDM)

- D Glazing:
 - 1. Basis of Design - PPG 60 Solar Ban - Low (E)
 - 2. Tint: Match existing window tint

2.06 ACCESSORIES

- A Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement waived if not installed on roof.
 - 1. Width: 8 Inches
 - 2. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 30 days of weather exposure.
 - 3. Products
 - a. Henry Company; FortiFlash
 - b. Or approved Substitute
- B Sheet Metal Flashing and Trim
 - 1. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch (0.61 mm) thick base metal, shop pre-coated with PVDF coating.
 - 2. Color: To match existing flashing

2.07 HARDWARE

- A For each door, include weatherstripping, sill sweep strip, and threshold.
- B Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- C Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
- D Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.
- E Hinges: Butt type, swing clear; top and bottom.
- F Push/Pull Set: Standard configuration push/pull handles.
- G Exit Devices: Panic type.
 - 1. Basis of Design: Falcom 1690 Concealed Rod Exit Device
- H Door Closers: Concealed overhead.
- I Locks: Dead latch with thumbturn inside ; keyed cylinder outside.
- J Wall Stope: Wall Mounted

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

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

- K Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 ADJUSTING

- A Adjust operating hardware and sash for smooth operation.

3.04 CLEANING

- A Remove protective material from pre-finished aluminum surfaces.
- B Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

END OF SECTION 08 43 13

**SECTION 08 71 00
DOOR HARDWARE**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Hardware for wood and hollow metal doors.
- B Thresholds.
- C Weatherstripping and gasketing.

1.02 RELATED REQUIREMENTS

- A Section 08 12 13 - Hollow Metal Frames.
- B Section 08 14 16 - Flush Wood Doors.

1.03 REFERENCE STANDARDS

- A ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B BHMA A156.1 - Standard for Butts and Hinges 2021.
- C BHMA A156.2 - Bored and Preassembled Locks and Latches 2017.
- D BHMA A156.3 - Exit Devices 2020.
- E BHMA A156.4 - Door Controls - Closers 2019.
- F BHMA A156.7 - Template Hinge Dimensions 2016.
- G BHMA A156.13 - Mortise Locks & Latches Series 1000 2017.
- H BHMA A156.16 - Auxiliary Hardware 2018.
- I BHMA A156.17 - Self Closing Hinges & Pivots 2019.
- J BHMA A156.18 - Materials and Finishes 2020.
- K BHMA A156.21 - Thresholds 2019.
- L BHMA A156.22 - Standard for Gasketing 2021.
- M BHMA A156.31 - Electric Strikes and Frame Mounted Actuators 2019.
- N BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames 2016.
- O BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames 2006.
- P DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors 1993; also in WDHS-1/WDHS-5 Series, 1996.
- Q ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- R NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.
- S NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- T UL (DIR) - Online Certifications Directory Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
- B Keying Requirements Meeting:
 - 1. Schedule meeting at project site prior to Contractor occupancy.
 - 2. Attendance Required:
 - a. Contractor.
 - b. Owner.
 - c. Architect.
 - 3. Agenda:
 - a. Establish keying requirements.
 - b. Verify locksets and locking hardware are functionally correct for project requirements.
 - c. Verify that keying and programming complies with project requirements.
 - d. Establish keying submittal schedule and update requirements.
 - 4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:

5. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.
6. Deliver established keying requirements to manufacturers.

1.05 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
- C Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
 1. Provide complete description for each door listed.
 2. Provide manufacturer name, product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
 3. Include account of abbreviations and symbols used in schedule.
- D Installer's qualification statement.
- E Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

1.06 QUALITY ASSURANCE

- A Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least two years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.08 WARRANTY

- A See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.
 1. Closers: Five years, minimum.
 2. Exit Devices: Three years, minimum.
 3. Locksets and Cylinders: Three years, minimum.
 4. Other Hardware: Two years, minimum.

PART 2 PRODUCTS**2.01 DESIGN AND PERFORMANCE CRITERIA**

- A Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B Provide individual items of single type, of same model, and by same manufacturer.
- C Provide door hardware products that comply with the following requirements:
 1. Applicable provisions of federal, state, and local codes.
 2. Accessibility: ADA Standards and ICC A117.1.
 3. Applicable provisions of NFPA 101.
 4. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
 5. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
- D Fasteners:
 1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
 - a. Aluminum fasteners are not permitted.

- b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
- 2. Fire-Rated Applications: Comply with NFPA 80.
 - a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
 - b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

2.02 HINGES

- A Hinges: Comply with BHMA A156.1, Grade 1.
 - 1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
 - a. Provide hinge width required to clear surrounding trim.
 - 2. Provide hinges on every swinging door.
 - 3. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
 - 4. Provide ball-bearing hinges at each door with closer.
 - 5. Provide following quantity of butt hinges for each door:
 - a. Doors From 60 inches (1.5 m) High up to 84 inches ([] m) High: Three hinges.
 - b. Doors 84 inches ([] m) High up to 120 inches (3 m) High: Four hinges.
 - 6. Electrified Hinges: Von Duprin EPT10/IVES Power transfer hinge or approved equal

2.03 EXIT DEVICES

- A Manufacturers:
 - 1. Von Duprin, an Allegion brand: www.allegion.com/us/#sle.
 - a. Basis of Design Products:
 - 1) QEL or EL 99 Series
- B Exit Devices: Comply with BHMA A156.3, Grade 1.
 - 1. Lever design to match lockset trim.
 - 2. Provide cylinder with cylinder dogging or locking trim.
 - 3. Provide exit devices properly sized for door width and height.
 - 4. Provide strike as recommended by manufacturer for application indicated.
 - 5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.04 LOCKSETS

- A Manufacturers:
 - 1. Schlage, an Allegion brand; www.allegion.com/us/#sle
 - a. Products: ND VandLGard
 - b. Lever Type: Match existing shape and finish within renovation projects
 - 2. Function: Per Hardware Schedule

2.05 CYLINDRICAL LOCKS

- A Manufacturers:
 - 1. Schlage, an Allegion brand: www.allegion.com/us/#sle.
 - a. Products: Full Size Interchangeable Core (FSIC) Cylinder
- B Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 1, 4000 Series.
 - 1. Bored Hole: 2-1/8 inch (54 mm) diameter.
 - 2. Latchbolt Throw: 1/2 inch (12.7 mm), minimum.
 - 3. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
 - 4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
 - a. Finish: 626 Brushed Stainless Steel

2.06 CLOSERS

- A Manufacturers; Surface Mounted:
 - 1. LCN, an Allegion brand; []: www.allegion.com/us/#sle.

a. Products:

- 1) LCN 4010 (Inward Swing)
- 2) LCN 4111 (Outward Swing)

B Closers: Comply with BHMA A156.4, Grade 1.

1. Type: Surface mounted to door.
2. Provide door closer on each exterior door.

2.07 KICK PLATES

A Kick Plates: Provide along bottom edge of push side of every door, except aluminum storefront and glass entry doors, unless otherwise indicated.

1. Material: Stainless Steel
2. Thickness - 18 Gauge
3. Size: 10 inch (□ mm) high by 2 inch (51 mm) less door width (LDW) on push side of door.
4. Kickplates: Comply with ANSI/BHMA 156.6 with BHMA 630 Finish

2.08 WALL STOPS

A Manufacturers:

1. Basis of Design: Ives or approved equal.

B Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.

1. Provide wall stops to prevent damage to wall surface upon opening door.
2. Type: Bumper, concave, wall stop.
3. Material: Aluminum housing with rubber insert.
4. Finish: Match door lever

2.09 THRESHOLDS

A Manufacturers:

1. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
2. National Guard Products, Inc: www.ngpinc.com/#sle.
3. Substitutions: See Section 01 60 00 - Product Requirements.

B Thresholds: Comply with BHMA A156.21.

1. Provide threshold at interior doors for transition between two different floor types, and over building expansion joints, unless otherwise indicated.
2. Provide threshold at each exterior door, unless otherwise indicated.
3. Type: Flat surface.
4. Material: Aluminum.
5. Threshold Surface: Fluted horizontal grooves across full width.
6. Field cut threshold to profile of frame and width of door sill for tight fit.
7. Provide non-corroding fasteners at exterior locations.

2.10 WEATHERSTRIPPING AND GASKETING

A Manufacturers:

1. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B Weatherstripping and Gasketing: Comply with BHMA A156.22.

1. Head and Jamb Type: Adjustable.
2. Door Sweep Type: Encased in retainer.
3. Material: Aluminum, with brush weatherstripping.

2.11 SILENCERS

A Manufacturers:

1. Ives, an Allegion brand: www.allegion.com/us/#sle.
2. Substitutions: See Section 01 60 00 - Product Requirements.

- B Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
 - 1. Single Door: Provide three on strike jamb of frame.
 - 2. Pair of Doors: Provide two on head of frame, one for each door at latch side.
 - 3. Material: Rubber, gray color.

2.12 FINISHES

- A Finishes: Provide door hardware of same finish, unless otherwise indicated.
 - 1. Primary Finish: Match existing finish within renovation projects; BHMA A156.18.
 - 2. Secondary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.
 - a. Use secondary finish in kitchens, bathrooms, and other spaces containing chrome or stainless steel finished appliances, fittings, and equipment; provide primary finish on one side of door and secondary finish on other side if necessary.

PART 3 EXECUTION

3.01 EXAMINATION

- A Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A Install hardware in accordance with manufacturer's instructions and applicable codes.
- B Use templates provided by hardware item manufacturer.
- C Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
 - 1. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.
- D Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.03 CLEANING

- A Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

3.04 PROTECTION

- A Protect finished Work under provisions of Section 01 70 00 - Execution and Closeout Requirements.
- B Do not permit adjacent work to damage hardware or finish.

END OF SECTION 08 71 00

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HW SET # S-01

Openings

PANIC HARDWARE FROM COMMONS

Each door or doors to have:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	99-L-BE-QM996-17-SNB	626	VON
1	EA	SURFACE CLOSER	4111 EDA TBWMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	SET	SEALS	S88D 20'	DKB	PEM

MATCH EXISTING SCHOOL STANDARD FOR LEVER TYPE AND DOOR HARDWARE FINISH

HW SET # S-02

Openings

TYPICAL CLASSROOM ENTRIES

Each door or doors to have:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	CLASSROOM LOCK	ND75PD SPA	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	SET	SEALS	S88D 20'	DKB	PEM

MATCH EXISTING SCHOOL STANDARD FOR LEVER TYPE AND DOOR HARDWARE FINISH

HW SET # S-01 (KINNAMAN)

Openings

EXTERIOR STOREFRONT DOOR; SEE DRAWINGS FOR HARDWARE FUNCTION. PROVIDE A FULL HARDWARE PACKAGE WITHIN SUBMITTAL PROCESS BY MANUFACTURER, INCLUDING CARD READER ACCESS FROM EXTERIOR

HW SET # S-02 (KIMMAMAN)

Openings

READING ROOMS

Each door or doors to have:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	ENTRANCE LOCK	ND53TD SPA	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	SET	SEALS	S88D 20'	DKB	PEM

SECTION 08 80 00**GLAZING****PART 1 GENERAL****1.01 REFERENCE STANDARDS**

- A ASTM C1036 - Standard Specification for Flat Glass 2021.
- B ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- C GANA (GM) - GANA Glazing Manual 2008.
- D GANA (SM) - GANA Sealant Manual 2008.
- E GANA (LGRM) - Laminated Glazing Reference Manual 2019.
- F IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use 1990 (2016).

1.02 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Product Data on Insulating Glass Unit, Glazing Unit, Plastic Sheet Glazing Unit, Plastic Film, and [] Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

1.03 QUALITY ASSURANCE

- A Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), IGMA TM-3000, and [] for glazing installation methods. Maintain one copy on site.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A Float Glass Manufacturers:
 - 1. Cardinal Glass Industries; []: www.cardinalcorp.com/#sle.
 - 2. Guardian Glass, LLC; []: www.guardianglass.com/#sle.
 - 3. Vitro Architectural Glass (formerly PPG Glass); []: www.vitroglazings.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B Laminated Glass Manufacturers:
 - 1. Cardinal Glass Industries; []: www.cardinalcorp.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- C Plastic Films Manufacturers:
 - 1. 3M Window Film; []: solutions.3m.com/wps/portal/3M/en_US/Window_Film/Solutions/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 GLASS MATERIALS

- A Float Glass: Provide float glass based glazing unless otherwise indicated.
 - 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
 - 2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.

2.03 PLASTIC FILMS

- A Type F-4 - Decorative Plastic Film: Polyester type.
 - 1. Application: Locations as indicated on drawings.
 - 2. Color: Acid Etch.
 - 3. Thickness Without Liner: 0.002 inch (0.051 mm).
 - 4. Width: 48 inch (1.2 m).

END OF SECTION 08 80 00

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SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL**1.01 RELATED REQUIREMENTS**

- A Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- B Section 09 22 16 - Non-Structural Metal Framing.

1.02 REFERENCE STANDARDS

- A ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017 (Reapproved 2022).
- B ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- C ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.
- D ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.
- E ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.
- F ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- G ASTM E413 - Classification for Rating Sound Insulation 2022.
- H GA-216 - Application and Finishing of Gypsum Panel Products 2021.

1.03 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

PART 2 PRODUCTS**2.01 GYPSUM BOARD ASSEMBLIES**

- A Provide completed assemblies complying with ASTM C840 and GA-216.
- B Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

2.02 BOARD MATERIALS

- A Manufacturers - Gypsum-Based Board:
 - 1. CertainTeed Corporation; []: www.certainteed.com/#sle.
 - 2. National Gypsum Company; []: www.nationalgypsum.com/#sle.
 - 3. USG Corporation; []: www.usg.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 - 2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 3. Thickness:
 - a. Vertical Surfaces: 5/8 inch (16 mm).
 - b. Ceilings: 5/8 inch (16 mm).

2.03 GYPSUM WALLBOARD ACCESSORIES

- A Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: [3 1/2"] inch ([] mm).
- B Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
 - 1. Products:

- a. Franklin International, Inc; Titebond GREENchoice Professional Acoustical Smoke and Sound Sealant: www.titebond.com/#sle.
 - b. Liquid Nails, a brand of PPG Architectural Coatings; []: www.liquidnails.com/#sle.
 - c. Specified Technologies Inc; Smoke N Sound Acoustical Sealant: www.stifirestop.com/#sle.
- C Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
- 1. Corner Beads: Low profile, for 90 degree outside corners.
 - a. Products:
 - 1) CertainTeed Corporation; No-Coat Drywall Corner: www.certainteed.com/#sle.
 - 2) ClarkDietrich; Strait-Flex Big-Stick: www.clarkdietrich.com/#sle.
 - 3) Phillips Manufacturing Co; Everlast Corner Bead: www.phillipsmfg.com/#sle.
 - 2. Corner Beads: Low profile, for connections at existing finishes
 - a. Products:
 - 1) ClarkDietrich; Muddable J-Bead - MJB58
 - 2) Substitutions: See Section 01 60 00-Product Requirements.
 - 3. Paper-Faced Reveal Trim: for ceilings and soffits
 - a. Products:
 - 1) ClarkDietrich; CD-TOR or PGR-5/8": www.clarkdietrich.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
- D Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
- 1. Paper Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
 - 2. Joint Compound: Drying type, vinyl-based, ready-mixed.
 - a. Products:
 - 1) CertainTeed Corporation; Extreme All-Purpose Joint Compound: www.certainteed.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3. Joint Compound: Setting type, field-mixed.
- E Finishing Compound: Surface coat and primer, takes the place of skim coating.
- 1. Products:
 - a. CertainTeed Corporation; Quick Prep Plus Interior Prep Coat: www.certainteed.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A Verify that project conditions are appropriate for work of this section to commence.

3.02 ACOUSTIC ACCESSORIES INSTALLATION

- A Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B Acoustic Sealant: Install in accordance with manufacturer's instructions.
- 1. Place one bead continuously on substrate before installation of perimeter framing members.
 - 2. Place continuous bead at perimeter of each layer of gypsum board.
 - 3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.03 BOARD INSTALLATION

- A Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

- A Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 - 1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
- B Corner Beads: Install at external corners, using longest practical lengths.
- C Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.05 JOINT TREATMENT

- A Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- B Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
 - 2. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- C Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
 - 2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
 - 3. Taping, filling, and sanding are not required at base layer of double-layer applications.
- D Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.06 TOLERANCES

- A Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

END OF SECTION 09 21 16

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SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Metal partition, ceiling, and soffit framing.
- B Framing accessories.

1.02 RELATED REQUIREMENTS

- A Section 06 10 00 - Rough Carpentry: Wood blocking within stud framing.
- B Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

- A AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members 2016, with Supplement (2020).
- B ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- C ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.
- D ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- E ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.

1.04 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
- C Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A Metal Framing, Connectors, and Accessories:
 - 1. CEMCO; []: www.cemcosteel.com/#sle.
 - 2. ClarkDietrich; []: www.clarkdietrich.com/#sle.
 - 3. SCAFCO Corporation; []: www.scafco.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FRAMING MATERIALS

- A Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf (L/240 at 240 Pa).
 - 1. Studs: C shaped with knurled or embossed faces.
 - 2. Runners: U shaped, sized to match studs.
- B Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
 - 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
 - 2. Material: ASTM A653/A653M steel sheet, SS Grade 50, with G60/Z180 hot-dipped galvanized coating.
- C Non-Loadbearing Framing Accessories:
 - 1. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3 1/2" inch ([] mm).

2. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

PART 3 EXECUTION

3.01 EXAMINATION

- A Verify existing conditions before starting work.

3.02 INSTALLATION OF STUD FRAMING

- A Comply with requirements of ASTM C754.
- B Extend partition framing to structure where indicated and to ceiling in other locations.
- C Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- D Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs as indicated.
- E Align and secure top and bottom runners at 24 inches (600 mm) on center.
- F Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- G Align stud web openings horizontally.
- H Secure studs to tracks using crimping method. Do not weld.
- I Fabricate corners using a minimum of three studs.
- J Install double studs at wall openings, door and window jambs, not more than 2 inches (50 mm) from each side of openings.
- K Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

3.03 CEILING AND SOFFIT FRAMING

- A Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- B Install furring independent of walls, columns, and above-ceiling work.
- C Securely anchor hangers to structural members or embed them in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- D Space main carrying channels at maximum 72 inch (1 800 mm) on center, and not more than 6 inches (150 mm) from wall surfaces. Lap splice securely.
- E Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- F Place furring channels perpendicular to carrying channels, not more than 2 inches (50 mm) from perimeter walls, and rigidly secure. Lap splices securely.

3.04 TOLERANCES

- A Maximum Variation From True Position: 1/8 inch in 10 feet (3 mm in 3 m).
- B Maximum Variation From Plumb: 1/8 inch in 10 feet (3 mm in 3 m).

END OF SECTION 09 22 16

**SECTION 09 65 00
RESILIENT FLOORING**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Resilient sheet flooring.
- B Resilient tile flooring.
- C Resilient base.

1.02 REFERENCE STANDARDS

- A ASTM F1861 - Standard Specification for Resilient Wall Base 2021.

1.03 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- D Verification Samples: Submit two samples, [] by [] inch ([] by [] mm) in size illustrating color and pattern for each resilient flooring product specified.

1.04 QUALITY ASSURANCE

- A Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B Store all materials off of the floor in an acclimatized, weather-tight space.
- C Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).
- D Protect roll materials from damage by storing on end.
- E Do not double stack pallets.

1.06 FIELD CONDITIONS

- A Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 PRODUCTS**2.01 SHEET FLOORING****2.02 RESILIENT BASE**

- A Resilient Base - Type []: ASTM F1861, Type TS rubber, vulcanized thermoset; style as scheduled.
 - 1. Manufacturers:
 - a. Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
 - b. Roppe Corporation; Contours Profiled Wall Base System: www.roppe.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Height: 4 inch (100 mm).
 - 3. Thickness: 0.125 inch (3.2 mm).
 - 4. Finish: Satin.
 - 5. Color: As indicated on drawings.

PART 3 EXECUTION**3.01 EXAMINATION**

- A Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

3.02 INSTALLATION - GENERAL

- A Starting installation constitutes acceptance of subfloor conditions.
- B Install in accordance with manufacturer's written instructions.

3.03 INSTALLATION - SHEET FLOORING

- A Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

3.04 INSTALLATION - RESILIENT BASE

- A Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
- B Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
- C Install base on solid backing. Bond tightly to wall and floor surfaces.
- D Scribe and fit to door frames and other interruptions.

3.05 CLEANING

- A Remove excess adhesive from floor, base, and wall surfaces without damage.
- B Clean in accordance with manufacturer's written instructions.

END OF SECTION 09 65 00

**SECTION 09 68 16
SHEET CARPETING**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Carpet, direct-glued.
- B Removal of existing carpet.

1.02 REFERENCE STANDARDS

- A CRI 104 - Standard for Installation of Commercial Carpet 2015.
- B CRI (GL) - Green Label Testing Program - Certified Products Current Edition.

1.03 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.

1.04 QUALITY ASSURANCE**PART 2 PRODUCTS****2.01 CARPET**

- A Carpet, Type WOM-1:
 - 1. Type: Synthetic Roll Flooring Entry Mat (Indoor/Outdoor)
 - 2. Product: Connexus, or equal
 - 3. Pattern: Super NOP 52
 - 4. Texture: Hobnail
 - 5. Construction: Non-Woven, needle punched, 100% ASOTA Polypropylene Solution Dyed Fiber
 - 6. Backing: Natural/Synthetic Composite Rubber
 - 7. Color: Per Drawings

2.02 ACCESSORIES

- A Subfloor Filler: Type recommended by carpet manufacturer.
- B Tackless Strip: Carpet gripper, of type recommended by carpet manufacturer to suit application, with attachment devices.
- C Adhesives:
 - 1. Compatible with materials being adhered; maximum VOC content of 50 g/L; CRI (GL) certified; in lieu of labeled product, independent test report showing compliance is acceptable.
- D Seam Adhesive: Recommended by carpet manufacturer.
- E Carpet Adhesive: Recommended by carpet manufacturer; releasable type.

PART 3 EXECUTION**3.01 EXAMINATION**

- A Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive carpet.
- B Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet.
- C Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesives to subfloor surfaces.

3.02 PREPARATION

- A Remove existing carpet and carpet cushion.
- B Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- C Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- D Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- E Clean substrate.

3.03 INSTALLATION - GENERAL

- A Starting installation constitutes acceptance of subfloor conditions.
- B Install carpet and cushion in accordance with manufacturer's instructions and CRI 104 (Commercial).
- C Verify carpet match before cutting to ensure minimal variation between dye lots.
- D Lay out carpet and locate seams in accordance with shop drawings.
 - 1. Locate seams in area of least traffic, out of areas of pivoting traffic, and parallel to main traffic.
 - 2. Do not locate seams perpendicular through door openings.
 - 3. Align run of pile in same direction as anticipated traffic and in same direction on adjacent pieces.
 - 4. Locate change of color or pattern between rooms under door centerline.
 - 5. Provide monolithic color, pattern, and texture match within any one area.
- E Install carpet tight and flat on subfloor, well fastened at edges, with a uniform appearance.

3.04 DIRECT-GLUED CARPET

- A Double cut carpet seams, with accurate pattern match. Make cuts straight, true, and unfrayed. Apply seam adhesive to cut edges of woven carpet immediately.
- B Apply contact adhesive to floor uniformly at rate recommended by manufacturer. After sufficient open time, press carpet into adhesive.
- C Apply seam adhesive to the base of the edge glued down. Lay adjoining piece with seam straight, not overlapped or peaked, and free of gaps.
- D Roll with appropriate roller for complete contact of adhesive to carpet backing.
- E Trim carpet neatly at walls and around interruptions.

3.05 CLEANING

- A Remove excess adhesive from floor and wall surfaces without damage.
- B Clean and vacuum carpet surfaces.

END OF SECTION 09 68 16

**SECTION 09 91 23
INTERIOR PAINTING**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Surface preparation.
- B Field application of paints.
- C Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
- D Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Floors, unless specifically indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

- A 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.
- B MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.
- C SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).
- D SSPC-SP 6 - Commercial Blast Cleaning 2007.

1.03 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
 - 2. MPI product number (e.g., MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.
 - 3. Allow 30 days for approval process, after receipt of complete samples by Architect.
- D Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
- E Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Paint and Finish Materials: 1 gallon (4 L) of each color; from the same product run, store where directed.
 - 3. Label each container with color in addition to the manufacturer's label.

1.04 DELIVERY, STORAGE, AND HANDLING

- A Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.05 FIELD CONDITIONS

- A Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A Provide paints and finishes from the same manufacturer to the greatest extent possible.
 - 1. If a single manufacturer cannot provide specified products; minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
- B Paints:
 - 1. Rodda Paint Co: www.roddapaint.com/#sle.
 - 2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 - 3. Miller Paint: www.millerpaint.com
 - 4. Kelly Moore: www.kellymoore.com
 - 5. As Approved by BSD Representative
- C Primer Sealers: Same manufacturer as top coats.

2.02 PAINTS AND FINISHES - GENERAL

- A Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 - 3. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B Volatile Organic Compound (VOC) Content:
 - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; www.otcair.org; specifically:
 - 1) Opaque, Flat: 50 g/L, maximum.
 - 2) Opaque, Nonflat: 150 g/L, maximum.
 - 3) Opaque, High Gloss: 250 g/L, maximum.
 - c. Architectural coatings VOC limits of OREGON.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

2.03 PAINT SYSTEMS - INTERIOR

- A Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, brick, wood, plaster, uncoated steel, shop primed steel, galvanized steel, aluminum, and acoustical ceilings.
 1. Two top coats and one coat primer.
 2. Primer Coat: PVA
 3. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144, 145, 146, 147, or 148.
 - a. Products:
 - 1) Basis of Design: Rodda Paint, Unique II .
 - b. Sheen: Semi-Gloss
- B Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
 1. Two top coats
 2. Top Coat(s): Interior Light Industrial Coating, Water Based; MPI #151, 153 or 154.
 - a. Products:
 - 1) Basis of Design: Rodda Multi Master DTM Acrylic Semi-Gloss Enamel, 548901. (MPI #153)

PART 3 EXECUTION

3.01 PREPARATION

- A Clean surfaces thoroughly and correct defects prior to application.
- B Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D Seal surfaces that might cause bleed through or staining of topcoat.
- E Concrete:
- F Masonry:
- G Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- H Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- I Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- J Galvanized Surfaces:
- K Ferrous Metal:
 1. Solvent clean according to SSPC-SP 1.
 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- L Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

3.02 APPLICATION

- A Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- D Sand wood and metal surfaces lightly between coats to achieve required finish.
- E Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

END OF SECTION 09 91 23

SECTION 09 93 00
STAINING AND TRANSPARENT FINISHING

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Surface preparation.
- B Field application of stains and transparent finishes.

1.02 REFERENCE STANDARDS

- A 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.
- B ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials 2020.
- C MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.

1.03 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B Samples: Submit two samples, illustrating selected colors and sheens for each system with specified coats cascaded. Submit on actual wood substrate to be finished, 12 x 12 inch (____ x ____ mm) in size.
- C Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Stain and Transparent Finish Materials: 1 gallon (4 L) of each color and type; from the same product run, store where directed.
 - 3. Label each container with color and type in addition to the manufacturer's label.

1.04 DELIVERY, STORAGE, AND HANDLING

- A Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B Container Label: Include manufacturer's name, type of stain or transparent finish, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C Stain and Transparent Finish Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.05 FIELD CONDITIONS

- A Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by manufacturer of stains and transparent finishes.
- B Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A Provide finishes from the same manufacturer to the greatest extent possible.

2.02 STAINS AND TRANSPARENT FINISHES - GENERAL

- A Finishes:
 - 1. Provide finishes capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 - 3. Supply each finish material in quantity required to complete entire project's work from a single production run.

4. Do not reduce, thin, or dilute finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B Volatile Organic Compound (VOC) Content:
 1. Provide stains and transparent finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; www.otcair.org; specifically:
 - 1) Opaque, Flat: 50 g/L, maximum.
 - 2) Opaque, Nonflat: 150 g/L, maximum.
 - 3) Opaque, High Gloss: 250 g/L, maximum.
 - 4) Varnishes: 350 g/L, maximum.
 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

2.03 INTERIOR STAIN AND TRANSPARENT FINISH SYSTEMS

- A Finish on Wood - Vertical Surfaces:
 1. Stain: Semi-Transparent Stain for Wood, Water Based; MPI #186.
 - a. Products:
 - 1) PPG Paints Deft Interior Water-Based Wood Stain, DFT300 Series. (MPI #186)
 - 2) Substitutions: Section 01 60 00 - Product Requirements.
 2. Top Coat(s): Polyurethane Varnish, Oil Modified; MPI #56 or 57.
 - a. Products:
 - 1) PPG Paints Deft Interior Polyurethane Oil-Based 350 VOC, DFT129, Satin.
 - 2) Substitutions: Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A Clean surfaces thoroughly and correct defects prior to application.
- B Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D Seal surfaces that might cause bleed through or staining of topcoat.

3.03 APPLICATION

- A Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- D Sand wood surfaces lightly between coats to achieve required finish.
- E Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

F Reinstall items removed prior to finishing.

3.04 CLEANING

A Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A Protect finishes until completion of project.

END OF SECTION 09 93 00

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SECTION 09 97 23
CONCRETE AND MASONRY COATINGS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Moisture resistant smooth concrete and masonry coatings.

1.02 REFERENCE STANDARDS

- A ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2019.
- B ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- C ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials 2013 (Reapproved 2021).

1.03 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B Product Data: Provide data indicating coating materials.

1.04 FIELD CONDITIONS

- A Do not install materials when temperature is below 55 degrees F (13 degrees C) or above 90 degrees F (32 degrees C).
- B Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- C Restrict traffic from area where coating is being applied or is curing.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A Concrete and Masonry Coatings:
 - 1. Evonik Protectosil ANTIGRAFFITI
 - 2. Substitutions: Section 01 60 00 - Product Requirements.

2.02 CONCRETE AND MASONRY COATINGS

- A Provide high-build, weather resistant coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
 - 1. Salt Spray Resistance: Passes when tested according to ASTM B117 for 2000 hours.
 - 2. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0, maximum, when tested in accordance with ASTM E84.
 - 3. Accelerated Outdoor Exposure: Passes when tested according to ASTM G153 for 5,000 hours.

2.03 MATERIALS

- A Coatings - General: Provide complete systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated.
 - 1. Maximum volatile organic compound (VOC) content: As required by applicable regulations.

PART 3 EXECUTION**3.01 EXAMINATION**

- A Verify existing conditions before starting work.
- B Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.
- C Masonry: Verify masonry joints are struck flush.

3.02 PREPARATION

- A Clean surfaces of loose foreign matter.
- B Remove substances that would bleed through finished coatings.
- C Remove finish hardware, fixture covers, and accessories and store.
- D Existing Painted and Sealed Surfaces:

1. Strip existing paint and coatings from surface.
 2. Clean with mixture of trisodium phosphate and water to remove surface grease and foreign matter.
- E Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

3.03 PRIMING

- A Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
- B Concrete and Masonry: Prior to priming, patch holes and indentations and fill cracks with manufacturer's recommended crack repair material.

3.04 COATING APPLICATION

- A Apply coatings in accordance with manufacturer's instructions, to thicknesses specified.
- B Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.05 CLEANING

- A Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B Clean surfaces immediately of overspray, splatter, and excess material.
- C After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

END OF SECTION 09 97 23

**SECTION 10 26 00
WALL AND DOOR PROTECTION**

PART 1 GENERAL**1.01 RELATED REQUIREMENTS**

- A Section 09 21 16 - Gypsum Board Assemblies: Placement of supports in stud wall construction.

1.02 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.

1.03 DELIVERY, STORAGE, AND HANDLING

- A Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.

PART 2 PRODUCTS**2.01 MANUFACTURERS****2.02 PRODUCT TYPES**

- A Corner Guards - Surface Mounted:
 - 1. Material: Type 304 stainless steel, No. 4 finish, 16 gauge, [] inch ([] mm) thick.
 - 2. Width of Wings: 2 inches (51 mm).
 - 3. Corner: Square.
 - 4. Color: 2B or better.
 - 5. Length: 48" One piece.
 - 6. Preformed end caps.
 - 7. Mounting: Countersunk stainless steel screws through factory-drilled holes

2.03 FABRICATION

- A Fabricate components with tight joints, corners and seams.
- B Pre-drill holes for attachment.
- C Form end trim closure by capping and finishing smooth.

PART 3 EXECUTION**3.01 EXAMINATION**

- A Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B Verify that substrate surfaces for adhered items are clean and smooth.

3.02 INSTALLATION

- A Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B Position corner guard 4 inches (102 mm) above finished floor to [] inches high ([] mm high).

3.03 TOLERANCES

- A Maximum Variation From Required Height: 1/4 inch (6 mm).

3.04 CLEANING

- A Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION 10 26 00

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SECTION 12 21 13
HORIZONTAL LOUVER BLINDS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Horizontal slat louver blinds.
- B Operating hardware.

1.02 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B Product Data: Provide data indicating physical and dimensional characteristics.
- C Samples: Submit two samples, [] inch ([] mm) long illustrating slat materials and finish, cord type and color.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A Horizontal Louver Blinds Without Side Guides:
 - 1. SWFcontract, a division of Springs Window Fashions, LLC; []:
www.swfcontract.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 BLINDS WITHOUT SIDE GUIDES

- A Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail.
- B Manual Operation: Control of raising and lowering by cord with full range locking; blade angle adjustable by control wand.
- C Metal Slats: Spring tempered pre-finished aluminum; square slat corners, with manufacturing burrs removed.
 - 1. Width: 1/2 inch (12 mm).
 - 2. Thickness: 0.008 inch (0.20 mm).
 - 3. Color: As selected by Architect.
- D Slat Support: Woven polypropylene cord, ladder configuration.
- E Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.
 - 1. Color: Same as slats.
- F Headrail Attachment: Wall brackets.

2.03 FABRICATION

- A Determine sizes by field measurement.

PART 3 EXECUTION**3.01 EXAMINATION**

- A Verify that openings are ready to receive the work.

3.02 INSTALLATION

- A Install blinds in accordance with manufacturer's instructions.
- B Secure in place with flush countersunk fasteners.

3.03 ADJUSTING

- A Adjust blinds for smooth operation.

3.04 CLEANING

- A Clean blind surfaces just prior to occupancy.

END OF SECTION 12 21 13

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SECTION 23 00 00
MECHANICAL AND PLUMBING BASIC REQUIREMENTS

PART 1 GENERAL**1.1 RELATED REQUIREMENTS**

- A. Specifications including divisions 00 and 01.
- B. Section 01 10 00 - Summary: Contract descriptions, description of alterations work, work by others, future work, occupancy conditions, use of site and premises, work sequence.
- C. Section 01 30 00 - Administrative Requirements: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.
- D. Section 01 31 14 - Facility Services Coordination.
- E. Section 01 41 00 - Regulatory Requirements.
- F. Section 01 42 16 - Definitions.
- G. Section 01 42 19 - Reference Standards: Consolidated list of citations with edition dates.
- H. Section 01 70 00 - Execution and Closeout Requirements: Examination, preparation, and general installation procedures; preinstallation meetings; cutting and patching; cleaning and protection; starting of systems; demonstration and instruction; closeout procedures except payment procedures; requirements for alterations work.
- I. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance (O&M) data, warranties and bonds.
- J. Section 01 79 00 - Demonstration and Training: Detailed requirements.
- K. Section 01 91 13 - General Commissioning Requirements.
- L. Section 02 41 00 - Demolition: Selective demolition, site demolition, structure removal.

1.2 SECTION INCLUDES

- A. Work included in 23 00 00, HVAC Basic Requirements applies to Division 23, HVAC work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of heating, ventilating and air conditioning systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.
 - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
 - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work provided.
 - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
 - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and othe

reviewing entity whose approval is required to obtain systems acceptance.

1.3 REFERENCE STANDARDS

- A. State of Oregon:
 - 1. OAR - Oregon Administrative Rules
 - 2. OESC - Oregon Electrical Specialty Code
 - 3. OFC - Oregon Fire Code
 - 4. OMSC - Oregon Mechanical Specialty Code
 - 5. OPSC - Oregon Plumbing Specialty Code
 - 6. OSSC - Oregon Structural Specialty Code
 - 7. OEESC - Oregon Energy Efficiency Specialty Code
 - 8. Oregon Elevator Specialty Code
- B. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 - 1. ABA - Architectural Barriers Act
 - 2. ABMA - American Bearing Manufacturers Association
 - 3. ADA - Americans with Disabilities Act
 - 4. AHRI - Air-Conditioning Heating & Refrigeration Institute
 - 5. AMCA - Air Movement and Control Association
 - 6. ANSI - American National Standards Institute
 - 7. ASCE - American Society of Civil Engineers
 - 8. ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers
 - 9. ASHRAE Guideline 0, The Commissioning Process
 - 10. ASME - American Society of Mechanical Engineers
 - 11. ASPE - American Society of Plumbing Engineers
 - 12. ASSE - American Society of Sanitary Engineering
 - 13. ASTM - ASTM International
 - 14. AWWA - American Water Works Association
 - 15. CFR - Code of Federal Regulations
 - 16. CGA - Compressed Gas Association
 - 17. CHPS - Collaborative for High Performance Schools
 - 18. CISPI - Cast Iron Soil Pipe Institute
 - 19. CSA - CSA International
 - 20. EPA - Environmental Protection Agency
 - 21. ETL - Electrical Testing Laboratories
 - 22. FDA - Food and Drug Administration
 - 23. FM - FM Global
 - 24. GAMA - Gas Appliance Manufacturers Association
 - 25. HI - Hydraulic Institute Standards
 - 26. IAPMO - International Association of Plumbing & Mechanical Officials
 - 27. ICC - International Code Council
 - 28. IFGC - International Fuel Gas Code
 - 29. ISO - International Organization for Standardization
 - 30. LEED - Leadership in Energy and Environmental Design
 - 31. MSS - Manufacturers Standardization Society
 - 32. NEC - National Electric Code

- 33. NEMA - National Electrical Manufacturers Association
- 34. NFPA - National Fire Protection Association
- 35. NFGC - National Fuel Gas Code
- 36. NRCA - National Roofing Contractors Association
- 37. NSF - National Sanitation Foundation
- 38. OSHA - Occupational Safety and Health Administration
- 39. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
- 40. TEMA - Tubular Exchanger Manufacturers Association
- 41. TIMA - Thermal Insulation Manufacturers Association
- 42. UL - Underwriters Laboratories, Inc.
- 43. USDA - United States Department of Agriculture
- 44. USGBC - United States Green Building Council
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- D. FM (AG) - FM Approval Guide current edition.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
 - 1. 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
 - 2. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
 - a. a. Label submittal to match numbering/references as shown in Contract Documents .Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
 - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 23, HVAC Specification Sections for specific items required in product data submittal outside of these requirements.
 - c. For vibration isolation of equipment, list make and model selected with operating load and deflection.

- d. See Division 23, HVAC individual Sections for additional submittal requirements.
3. Maximum of two reviews of submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
4. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
5. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet Section 23 05 48, and provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
6. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required by Division 23, HVAC Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.
7. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
8. Substitutions and Variation from Basis of Design:
 - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
9. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, equipment, ductwork and piping layout plans, and control wiring diagrams. Reference individual Division 23, HVAC Specification Sections for additional requirements for shop drawings outside of these requirements.
 - a. Provide Shop Drawings indicating access panel locations for items that require Code or maintenance access, size and elevation for approval prior to installation.
10. Samples: Provide samples when requested by individual Sections.

11. Resubmission Requirements: Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
 - a. Resubmit for review until review indicates no exception taken or make "corrections as noted".
 - b. When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.
12. Operation and Maintenance Manuals:
 - a. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
 - 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.
 - 3) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, and individual Sections.
 - 4) Include product certificates of warranties and guarantees.
 - 5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub-assemblies.
 - 6) Include copy of startup and test reports specific to each piece of equipment.
 - 7) Include copy of final air and water systems balancing log along with pump, fan and distribution system operating data.
 - 8) Include commissioning reports.
 - 9) Include copy of valve charts/schedules.
 - 10) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
 - b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 23 00 00, HVAC Basic Requirements Article titled "Demonstration".

- c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance, and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
- D. Product Data & Shop Drawings: Provide product submittals and shop drawings in electronic format (pdf).
- E. Record Drawings:
 - 1. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
 - 2. Record Drawings are to include equipment and fixture/connection schedules, control dampers, fire smoke dampers, fire dampers, valves, bottom of pipe, duct and equipment elevations and dimensioned locations for all distribution systems (hydronic and air). Invert elevations and dimensioned locations for underground systems below grade to 5-feet outside building that accurately reflect "as constructed or installed" for project.
 - 3. At completion of project, input changes to original project Revit Model and make one set of black-line drawings created from Revit Model in version/release equal to contract drawings. Submit drawings upon substantial completion.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL and CSA listed.
- G. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

- H. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.
- I. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.
- J. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- K. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- L. Coordination Documents:
 - 1. Prior to construction, prepare and submit coordinated layout drawings (composite drawings), to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, plumbing, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, fire protection, electrical, ceiling suspension, and ceiling tile systems, etc.), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence. Unless otherwise required by Division 00, Procurement and Contracting Requirements and/or Division 01, General Requirements, Division 23, HVAC to combine information furnished by other trades onto master coordination documents.
 - 2. Prepare Drawings as follows:
 - a. Coordination models/drawings may be created using Revit 3D modeled elements or a 3D CAD software. The modeled elements to be graphically represented within the model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the model elements. Model elements must have the ability to be spatially coordinated with other modeled elements using either Revit, Autodesk Navisworks or Autodesk A360.
 - b. Drawings in Revit Mode release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.
 - c. Review and revise, as necessary, section cuts in Contract Drawings after verification of field conditions.
 - d. Indicate hydronic and air distribution system piping including fittings, hangers, access panels, valves, and bottom of pipe and duct elevations above finished floor.
 - e. Indicate inverts and provision for piping that must be graded to have right-of-way over more flexible items. Drawings also to indicate proposed ceiling grid and lighting layout as shown on electrical drawings and architectural reflected ceiling drawings and HVAC equipment, ductwork and piping.
 - f. Incorporate Addenda items and change orders.
 - g. Distribute drawings to trades and provide additional coordination as requested by other trades.

3. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
4. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
5. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 ACCESS PANELS

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 23, HVAC Sections. In absence of specific requirements in Division 01, General Requirements, comply with the following:
 1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
 - a. Ceiling access panels to be minimum 24-inch by 24-inch required and approved size.
 - b. Wall access panels to be minimum of 12-inch by 12-inch required and approved size.
 - c. Provide screwdriver operated catch; cylinder type locks. Provide two keys for each cylinder. Locks to be keyed for Master Keying; or cylinder type locks. Provide two keys for each cylinder. Locks to be keyed for or sequential keying system.
 - d. Manufacturers and Models:
 - 1) Drywall: Karp KDW.
 - 2) Plaster: Karp DSC-214PL.
 - 3) Masonry: Karp DSC-214M.
 - 4) 2 hour rated: Karp KPF-350FR.
 - 5) Manufacturers: Milcor, Elmdor, Acudor or approved equivalent.

PART 3 EXECUTION

3.1 INSTALLATION AND ACCESSIBILITY

- A. Install in accordance with manufacturer's instructions.
- B. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- C. Install equipment having components requiring access (i.e., drain pans, drains, control operators, valves, motors and vibration isolation devices) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- D. Install equipment and products complete as directed by manufacturer's installation instructions including all appurtenances recommended in manufacturer's installation instructions, at no

additional charge to Owner. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.

E. Earthwork:

1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork Sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

F. Firestopping:

1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

G. Pipe Installation:

1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building, as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, seismic flexible joints, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems. Include provisions for servicing and removal of equipment without dismantling piping.

- H. Plenums: Materials within plenums shall be noncombustible or shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723. Immediately notify Architect / Engineer of any discrepancy.

3.2 COMMISSIONING

- A. See Section 01 91 13 - General Commissioning Requirements, for commissioning requirements.

3.3 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment, Division

13, Special Construction, and individual Division 23 HVAC Sections.

1. General: Earthquake resistant designs for HVAC (Division 23) equipment and distribution, i.e. motors, ductwork, piping, equipment, etc. to conform to regulations of jurisdiction having authority.
2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority. Provide stamped Shop Drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for piping equipment and water heaters. Submit Shop Drawings along with equipment submittals.
3. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details.
4. Piping and Ductwork: Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.
5. Provide means to prohibit excessive motion of mechanical equipment during earthquake.

3.4 DEMOLITION

- A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 1. Scope: It is the intent of these documents to provide necessary information and adjustments to the HVAC system required to meet code, and accommodate installation of new work. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
 2. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
 3. Equipment: Unless otherwise directed, equipment, fixtures, or fittings being removed as part of demolition process are Owner's property. Remove other items not scheduled to be reused or relocated from job site as directed by Owner.
 4. Unless specifically indicated on Drawings, remove exposed, unused ductwork and piping to behind finished surfaces (floor, walls, ceilings, etc.). Cap and patch surfaces to match surrounding finish.
 5. Unless specifically indicated on Drawings, remove unused equipment, fixtures, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).

3.5 CUTTING AND PATCHING

- A. Confirm Cutting and Patching requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs

are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).

2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.6 TEMPORARY HEATING, COOLING, AND HUMIDITY CONTROL

- A. Provide temporary heating, cooling, controls, humidification and dehumidification as required to facilitate the construction of the project. Size and select temporary system based on the requirements of the various trades during construction. This includes, but is not limited to, drywall, case work, wood flooring and wood finishes that are subject to warping. Size and install system to prevent mold growth. Coordinate the location of the temporary system. The house system can be used. Develop a procedure for how the house system will be used including a sketch depicting the house system, how filtration will be used to prevent construction debris from entering the system and how often the filters will be changed, how the ductwork will be cleaned after use to ensure a clean system is turned over to the Owner and how the units are sized. Submit this procedure to the Mechanical Engineer for review. Follow National Air Duct Cleaners Association (NADCA) duct cleaning procedures and guidelines. Warranties for the house system, if new, to commence when the Owner moves in if house system is used as the means to maintain the climate within the building during construction. Include this warranty requirement in the original bid or proposal amount. Coordinate and provide any temporary power, controls, ductwork, piping, plumbing anchorage, miscellaneous steel and structural supports required to support the temporary system. Installation of the system to comply with all applicable codes and be acceptable to the Authority Having Jurisdiction (AHJ).

3.7 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.
- B. Maintain design intent where equipment other than as shown as Basis of Design in Contract Documents is provided. Where equipment requires ductwork or piping arrangement, controls/control diagrams, or sequencing different from that indicated in Contract Documents, provide at no additional cost to Owner.

3.8 CLEANING

- A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.9 INSTALLATION

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment. Do not place equipment in sustained operation prior to initial balancing of HVAC systems.
- D. Provide miscellaneous supports/metals required for installation of equipment, piping and ductwork.
- E. Electrical interlocks: Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

3.10 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following: Coordinate locations/sizes of access panels with Architect prior to work.

3.11 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 - 1. Underground system installation prior to backfilling.
 - 2. Prior to covering walls.
 - 3. Prior to ceiling cover/installation.
 - 4. After major equipment is installed.
 - 5. When main systems, or portions of, are being tested and ready for inspection by AHJ.
 - 6. Final Punch.
- C. Costs incurred by additional final punch list trips required due to incomplete systems will be the responsibility of the Contractor.

3.12 DEMONSTRATION, TRAINING, AND CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.

2. Briefly describe function, operation, and maintenance of each component.
- D. Training: Train Owner's personnel on operation and maintenance of system.
 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 2. Provide minimum of two hours of training.
 3. Instructor: Manufacturer's training personnel.
- E. Acceptance:
 1. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - a. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - 1) Testing and Balancing Reports
 - 2) Cleaning
 - 3) Operation and Maintenance Manuals
 - 4) Training of Operating Personnel
 - 5) Record Drawings
 - 6) Warranty and Guaranty Certificates
 - 7) Start-up/Test Document
 - 8) Commissioning Reports
- F. Letter of Conformance
 1. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that HVAC items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

END OF SECTION

SECTION 23 05 16
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.
- C. Pipe loops, offsets, and swing joints.

1.2 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping.
- B. Section 23 22 13 - Steam and Condensate Heating Piping.

1.3 REFERENCE STANDARDS

- A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.
- B. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard 2020.
- C. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded 2021.
- D. EJMA (STDS) - EJMA Standards Tenth Edition.
- E. FM (AG) - FM Approval Guide current edition.
- F. UL (DIR) - Online Certifications Directory Current Edition.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

PART 2 PRODUCTS**2.1 FLEXIBLE PIPE CONNECTORS - STEEL PIPING**

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 2. The Metraflex Company: www.metraflex.com/#sle.
- B. Inner Hose: Stainless Steel.
- C. Exterior Sleeve: Single braided, stainless steel.
- D. Pressure Rating: 125 psi and 450 degrees F.
- E. Joint: Flanged.
- F. Size: Use pipe sized units.
- G. Maximum offset: 3/8 inch on each side of installed center line.

2.2 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 2. The Metraflex Company: www.metraflex.com/#sle.

- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 psi and 450 degrees F.
- E. Joint: Flanged.
- F. Size: Use pipe sized units.
- G. Maximum offset: 3/8 inch on each side of installed center line.
- H. Application: Copper piping.

2.3 EXPANSION JOINTS - SINGLE SPHERE, FLEXIBLE COMPENSATOR

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 2. The Metraflex Company; Cablesphere: www.metraflex.com/#sle.
- B. Body: Teflon.
- C. Pressure Rating, Sizes 1-1/2 Inch to 12 Inch: 150 psi and 250 degrees F.
- D. Maximum Compression: 1/2 inch.
- E. Maximum Elongation: 3/8 inch.
- F. Maximum Offset: 3/8 inch.
- G. Maximum Angular Movement: 15 degrees.
- H. Joint: Tapped steel flanges.
- I. Size: Use pipe sized units.
- J. Accessories: Control cables.
- K. Application: Steel piping 2 inches and over.

2.4 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

- A. Manufacturers:
 - 1. The Metraflex Company; Metraloop: www.metraflex.com/#sle.
- B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support bracket and air release or drain plug.
- C. Provide flexible loops capable of movement in the x, y, and z planes. Flexible loops to impart no thrust loads to the building structure.
- D. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
 - 1. Maximum Allowable Working Pressure: 150 psig at 120 degrees F.
 - 2. Accommodate the Following:
 - a. Angular Rotation: 15 degrees.
 - b. Force developed by 1.5 times specified maximum allowable operating pressure.
 - 3. End Connections: Same as specified for pipe jointing.
 - 4. Provide necessary accessories including, but not limited to, swivel joints.

2.5 ACCESSORIES

- A. Pipe Alignment Guides:
 - 1. Manufacturers:
 - a. The Metraflex Company; PGQ Glide Riser Guide: www.metraflex.com/#sle.
 - 2. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.
- B. Engineered Riser Anchor Clamps:
 - 1. Manufacturers:

- a. The Metraflex Company; Engineered Riser Anchor Clamp: www.metraflex.com/#sle.
- 2. Applications:
 - a. Provide one clamp to serve as a riser clip.
 - 1) Verify the total load of filled pipe to be supported will be a safety factor of one less than the maximum loading of the clamp per the manufacturer's instructions.
 - b. Provide one clamp above and one clamp below the slab to anchor pipe.
 - 1) Coordinate with the structural engineer to determine the maximum thrust loading calculated for the slab or floor structure. Use the maximum thrust loading calculations to verify the clamps will be a safety factor of one less than the maximum loading of clamp per the manufacturer's instructions.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- E. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.
- F. Substitute grooved piping for vibration isolated equipment instead of flexible connectors. Grooved piping need not be anchored.

END OF SECTION

SECTION 23 05 19
METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Pressure gauges and pressure gauge taps.
- B. Thermometers and thermometer wells.
- C. Static pressure gauges.
- D. Filter gauges.

1.2 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping.
- B. Section 23 22 13 - Steam and Condensate Heating Piping.

1.3 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments 2013.
- B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi 2004 (Reaffirmed 2017).
- C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers 2014 (Reapproved 2020).
- D. UL 393 - Indicating Pressure Gauges for Fire-Protection Service Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

1.5 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS**2.1 LIQUID FLOW METERS**

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 - 2. Veris Industries: www.veris.com/#sle.
 - 3. Onicon.
- B. Calibrated ASME MFC-3M Venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gauge in case.
- C. Annular element flow stations with meter set.
 - 1. Measuring Station: Type 316 stainless steel pitot type flow element inserted through welded threaded couplet, with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.
 - a. Accuracy: Plus 0.55 percent to minus 2.30 percent.

2.2 PRESSURE GAUGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.

2. Weksler GTC.
- B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, brass bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 1. Case: Steel with brass bourdon tube.
 2. Size: 4 inch diameter.
 3. Mid-Scale Accuracy: One percent.
 4. Scale: Psi and KPa.

2.3 PRESSURE GAUGE TAPPINGS

- A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.
 1. Manufacturers:
 - a. Weksler GTC Model A10.

2.4 DIAL THERMOMETERS

- A. Manufacturers:
 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 2. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
- B. Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
 1. Size: 3 inch diameter dial.
 2. Lens: Clear glass.
 3. Accuracy: 1 percent.
 4. Calibration: Degrees F.

2.5 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.6 TEST PLUGS

- A. Manufacturers:
 1. Pete's Plug II, Peterson Equipment Co..
- B. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.
- C. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gauges, one gauge adapters with 1/8 inch probes, two 1 inch dial thermometers.

2.7 STATIC PRESSURE GAUGES

- A. Manufacturers:
 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 2. Veris Industries: www.veris.com/#sle.
 3. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
- B. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- C. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.
- D. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- C. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- D. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.
- E. Coil and conceal excess capillary on remote element instruments.
- F. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- G. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- H. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- I. Locate test plugs adjacent thermometers and thermometer sockets.

END OF SECTION

SECTION 23 05 29**HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Support and attachment components.

1.2 RELATED REQUIREMENTS

- A. Section 23 05 48 - Vibration and Seismic Controls for HVAC.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- E. MFMA-4 - Metal Framing Standards Publication 2004.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
 - 1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
 - 1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS**2.1 SUPPORT AND ATTACHMENT COMPONENTS**

- A. General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
 - 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 - 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads

- where applicable.
4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
 - B. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 1. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 2. Comply with MFMA-4.
 3. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 - C. Hanger Rods:
 1. Threaded zinc-plated steel unless otherwise indicated.
 - D. Thermal Insulated Pipe Supports:
 1. General Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Pipe supports to be provided for nominally sized, 1/2 to 30 inch iron pipes.
 - d. Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by a 360 degree, PVC jacketing.
 - E. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
 1. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 2. Provide steel pedestals with thermoplastic or rubber base 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.
 3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 5. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
 - F. Anchors and Fasteners:
 1. Manufacturers - Mechanical Anchors:
 - a. Hilti, Inc: www.us.hilti.com/#sle.
 - b. Powers Fasteners, Inc: www.powers.com/#sle.

- c. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
2. Manufacturers - Powder-Actuated Fastening Systems:
 - a. Hilti, Inc: www.us.hilti.com/#sle.
 - b. Powers Fasteners, Inc: www.powers.com/#sle.
 - c. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
3. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
4. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
5. Wood: Use wood screws.
6. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- G. Equipment Support and Attachment:
 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners according to manufacturer's recommended torque settings.
- J. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 23 05 23
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Ball valves.
- B. Butterfly valves.
- C. Check valves.

1.2 RELATED REQUIREMENTS

- A. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- B. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- C. Section 23 07 19 - HVAC Piping Insulation.
- D. Section 23 21 13 - Hydronic Piping.
- E. Section 23 22 13 - Steam and Condensate Heating Piping.

1.3 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch 2013 (Reaffirmed 2018).
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.
- C. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves 2022.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.
- E. ASME B16.34 - Valves — Flanged, Threaded, and Welding End 2020.
- F. ASME B31.9 - Building Services Piping 2020.
- G. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings 2004 (Reapproved 2019).
- H. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures 1999 (Reapproved 2022).
- I. ASTM A536 - Standard Specification for Ductile Iron Castings 1984, with Editorial Revision (2019).
- J. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings 2017.
- K. MSS SP-45 - Drain and Bypass Connections 2020.
- L. MSS SP-67 - Butterfly Valves 2022.
- M. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends 2011.
- N. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends 2018.
- O. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service 2010a.
- P. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves 2019.
- Q. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010, with Errata .
- R. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided 2018.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 - 5. Secure check valves in either the closed position or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

PART 2 PRODUCTS**2.1 APPLICATIONS**

- A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- B. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- C. Required Valve End Connections for Non-Wafer Types:
 - 1. Steel Pipe:
 - a. Size 2 inch and Smaller: Threaded ends.
 - b. Size 2-1/2 inch and Larger: Grooved ends.
 - 2. Copper Tube:
 - a. Size 2 inch and Smaller: Threaded ends, except solder-joint valve-ends.
 - b. Size 2-1/2 inch and Larger: Grooved ends.
 - 3. Steam and Steam Condensate Pipe: Grooved ends not acceptable.
- D. Chilled Water Valves:
 - 1. Size 2 inch and Smaller, Brass and Bronze Valves:
 - a. Threaded ends.
 - b. Ball: Full port, two piece, brass trim.
 - c. Swing Check: Bronze disc, Class.
 - 2. Size 2-1/2 inch and Larger, Iron Valves:
 - a. 2-1/2 inch to 4 inch: Threaded ends.
 - b. Ball: 2-1/2 NPS to 10 inch, Class 150.
 - c. Swing Check: Metal seats, Class 125.
- E. Condenser Water Valves:
 - 1. Size 2 inch and Smaller, Brass and Bronze Valves:
 - a. Threaded ends.
 - b. Ball: Full port, one piece, brass trim.
 - c. Swing Check: Bronze disc, Class 125.
 - 2. Size 2-1/2 inch and Larger, Iron Valves:
 - a. 2-1/2 inch to 4 inch: Threaded ends.

- b. Ball: 2-1/2 inch to 10 inch, Class 150.
 - c. Swing Check: Metal seats, Class 125.
- F. Heating Hot Water Valves:
 - 1. 2 NPS and Smaller, Bronze and Steel Valves:
 - a. Threaded ends.
 - b. Ball: Full port, two piece, brass trim.
 - c. Wafer Check: Bronze disc, Class 150.
 - 2. Size 2-1/2 inch and Larger, Iron Valves:
 - a. 2-1/2 NPS to 4 NPS: Flanged ends.
 - b. Ball: 2-1/2 inch to 10 inch, Class 150.
 - c. Single-Flange Butterfly: 2-1/2 inch to 12 inch, aluminum-bronze disc, EPDM seat, 200 CWP.
 - d. Wafer Check: Compact-wafer, metal seat, Class 150.

2.2 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
 - 1. Hand Lever: Quarter-turn valves 6 NPS and smaller.
- D. Valves in Insulated Piping: Provide 2 inch stem extensions and the following features:
 - 1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- E. Memory Stops: Fully adjustable after insulation is installed.
- F. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
 - 3. Solder Joint Connections: ASME B16.18.
- G. General ASME Compliance:
 - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 - 2. Building Services Piping Valves: ASME B31.9.
- H. Bronze Valves:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- I. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRASS, BALL VALVES

- A. Two Piece, Full Port with Brass Trim:
 - 1. Comply with MSS SP-110.
 - 2. Seats: PTFE.
 - 3. Stem: Stainless Steel.
 - 4. Ball: Chrome-plated brass.
 - 5. Manufacturers:
 - a. Apollo.

2.4 IRON, BALL VALVES

- A. Split Body, Full Port:

1. Comply with MSS SP-72.
2. CWP Rating: 200 psi.
3. Body: ASTM A126, gray iron.
4. Ends: Flanged.
5. Seats: PTFE.
6. Stem: Stainless steel.
7. Ball: Stainless steel.

2.5 IRON, SINGLE FLANGE BUTTERFLY VALVES

- A. Lug Style; Bidirectional dead-end service without use of downstream flange:
 1. Comply with MSS SP-67, Type I.
 2. Lug Style, CWP Ratings:
 - a. Sizes 2 to 12 inch: 150 psi.
 - b. Sizes 14 to 24 inch: 100 psi.
 - c. Vacuum Service: Down to 29.9 in-Hg.
 3. Stem: One or two-piece stainless steel.
 4. Seat: EPDM.
 5. Disc: Aluminum-bronze.
 6. Manufacturers:

2.6 BRASS, HORIZONTAL SWING CHECK VALVES

- A. Threaded End-Connections:
 1. Class 125: CWP Rating: 200 psi.
 2. Body: Forged brass.
 3. Disc: Forged brass.
 4. Hinge-Pin, Screw, and Cap: Forged brass.

2.7 BRONZE, SWING CHECK VALVES

2.8 IRON, FLANGED END SWING CHECK VALVES

2.9 IRON, CENTER-GUIDED CHECK VALVES

- A. Class 150, Compact-Wafer:
 1. Comply with MSS SP-125.
 2. Sizes 2-1/2 to 12 inch: CWP Rating; 300 psi.
 3. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
 4. Resilient Seat: Buna-N.
 5. Manufacturers:
 - a. Titan Flow Control, Inc..

PART 3 EXECUTION

3.1 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.2 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.
- D. Install check valves where necessary to maintain direction of flow as follows:
 - 1. Lift Check: Install with stem plumb and vertical.
 - 2. Swing Check: Install horizontal maintaining hinge pin level.
 - 3. Orient plate-type and center-guided into horizontal or vertical position, between flanges.

END OF SECTION

SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Vibration isolation requirements.
- B. Seismic control requirements.
 - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- C. Vibration isolators.
- D. Seismic restraint systems.

1.2 RELATED REQUIREMENTS

- A. Section 01 45 33 - Code-Required Special Inspections and Procedures.

1.3 DEFINITIONS

- A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.4 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings 2016.
- C. ASHRAE (HVAC) - ASHRAE Handbook - HVAC Applications Most Recent Edition Cited by Referring Code or Reference Standard.
- D. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment 2014.
- E. FEMA 413 - Installing Seismic Restraints for Electrical Equipment 2004.
- F. FEMA 414 - Installing Seismic Restraints for Duct and Pipe 2004.
- G. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage 2012.
- H. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components 2010, with Editorial Revision (2015).
- I. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems 2008.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
 - 2. Seismic Controls: Include seismic load capacities.
- D. Shop Drawings - Vibration Isolation Systems:
 - 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.

- E. Shop Drawings - Seismic Controls:
 - 1. Include dimensioned plan views and sections indicating proposed HVAC component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
 - 2. Identify mounting conditions required for equipment seismic qualification.
 - 3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
 - 4. Indicate proposed arrangement of distributed system trapeze support groupings.
 - 5. Indicate proposed locations for distributed system flexible fittings and/or connections.
 - 6. Indicate locations of seismic separations where applicable.
- F. Seismic Design Data:
 - 1. Compile information on project-specific characteristics of actual installed HVAC components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
 - a. Component operating weight and center of gravity.
 - b. Component elevation in the building in relation to the roof elevation (z/h).
 - c. Component importance factor (I_p).
 - d. For distributed systems, component materials and connection methods.
 - e. Component amplification factor (a_p) and component response modification factor (R_p), determined in accordance with ASCE 7 tables.

1.6 QUALITY ASSURANCE

- A. Comply with applicable building code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 - 1. Select vibration isolators to provide required static deflection.
 - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
 - 3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
 - 4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
 - 5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.
- D. Piping Isolation:
 - 1. Provide vibration isolators for piping supports:
 - a. Located in equipment rooms.

- b. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
2. Minimum Static Deflection:
 - a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
 - b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
4. Suspended Piping, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
5. Use modular seal or approved resilient material where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

2.2 SEISMIC CONTROL REQUIREMENTS

- A. Design and provide HVAC component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor HVAC components.
- B. Seismic Design Criteria: Obtain from project Structural Engineer of Record.
- C. Component Importance Factor (Ip): HVAC components essential to life safety to be assigned a component importance factor (Ip) of 1.5 as indicated or as required. This includes but is not limited to:
 1. HVAC components required to function for life safety purposes after an earthquake.
 2. HVAC components that support or otherwise contain hazardous substances.
- D. Seismic Qualification of Equipment:
 1. Provide special certification for HVAC equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
 2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
 3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- E. Seismic Restraints:
 1. Provide seismic restraints for HVAC components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
 2. Seismic Restraint Exemptions:
 - a. Exemptions for Seismic Design Category C:
 - 1) HVAC components where either of the following apply:
 - (a) The component importance factor (Ip) is 1.0 and the component is positively attached to the structure.
 - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.

- 2) HVAC piping with component importance factor (I_p) of 1.5 and nominal pipe size of 2 inch or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
- b. Exemptions for Seismic Design Category D, E, and F:
 - 1) Discrete HVAC components that are positively attached to the structure where either of the following apply:
 - (a) The component weighs 400 pounds or less, has a center of mass located 4 feet or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor (I_p) is 1.0.
 - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
 - 2) HVAC piping with component importance factor (I_p) of 1.0 and nominal pipe size of 3 inch or less, or with component importance factor (I_p) of 1.5 and nominal pipe size of 1 inch or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
- c. Duct System Exemptions, All Seismic Design Categories:
 - 1) Duct systems not designed to carry toxic, highly toxic, or flammable gases and not used for smoke control with component importance factor (I_p) of 1.0, where flexible connections or other assemblies are provided between duct system and associated components, where duct system is positively attached to the structure, and where one of the following apply:
 - (a) Trapeze supported duct with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
 - (b) Trapeze supported duct with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 200 pounds or less.
 - (c) Trapeze supported duct with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
 - (d) Hanger supported duct with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds or less.
 - 2) Duct systems not designed to carry toxic, highly toxic, or flammable gases and not used for smoke control, where there are provisions to avoid impact with other ducts or mechanical components or to protect ducts in the event of such impact, and where duct system is positively attached to the structure and has a cross sectional area of less than 6 square feet and weighs 20 pounds per foot or less.

- d. HVAC Piping Exemptions, All Seismic Design Categories:
 - 1) HVAC piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:
 - (a) Trapeze supported piping weighing less than 10 pounds per foot, where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.
 - (b) Trapeze supported piping with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.
 - (c) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds or less.
 - (d) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.
 - (e) Hanger supported piping with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, where pipe has a component importance factor (Ip) of 1.0 and meets size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds or less.
- 3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
 - a. ASHRAE (HVACA).
 - b. FEMA 412.
 - c. FEMA 413.
 - d. FEMA 414.
 - e. FEMA E-74.
 - f. SMACNA (SRM).
- 4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
- 5. Seismic Type Vibration Isolators:
 - a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
- 6. Seismic Restraint Systems:
 - a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
 - b. Use only cable restraints to restrain vibration-isolated HVAC components, including distributed systems.
 - c. Use only one restraint system type for a given HVAC component or distributed system (e.g., ductwork, piping) run; mixing of cable and rigid restraints on a given

- component/run is not permitted.
- d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain HVAC component in all lateral directions; consider bracket geometry in anchor load calculations.
- e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported HVAC component weight.
- f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported HVAC component weight.
- g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
- h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
- i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
- 7. Ductwork Applications:
 - a. Provide independent support and seismic restraint for in-line components (e.g., fans, heat exchangers, humidifiers) having an operating weight greater than 75 pounds.
 - b. Positively attach appurtenances (e.g., dampers, louvers, diffusers) with mechanical fasteners.
- F. Seismic Attachments:
 - 1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
 - 2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
 - 3. Do not use power-actuated fasteners.
 - 4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
 - 5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
 - 6. Concrete Housekeeping Pads:
 - a. Increase size of pad as required to comply with anchor requirements.
 - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.
- G. Seismic Interactions:
 - 1. Include provisions to prevent seismic impact between HVAC components and other structural or nonstructural components.

2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
 3. Comply with minimum clearance requirements between HVAC equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.
- H. Seismic Relative Displacement Provisions:
1. Use suitable fittings or flexible connections to accommodate:
 - a. Relative displacements at connections between components, including distributed systems (e.g., ductwork, piping); do not exceed load limits for equipment utility connections.
 - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
 - c. Design displacements at seismic separations.
 - d. Anticipated drifts between floors.

2.3 VIBRATION ISOLATORS

- A. Manufacturers:
1. Vibration Isolators:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
- B. General Requirements:
1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
 2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
 - f. Selected to function without undue stress or overloading.
 3. Seismic Snubbing Elements for Seismic Isolators:
 - a. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
 - b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.
- C. Vibration Isolators for Nonseismic Applications:
1. Resilient Material Isolator Pads:
 - a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
 - b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
 - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
 2. Resilient Material Isolator Mounts, Nonseismic:
 - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe

- type.
3. Spring Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
 - D. Vibration Isolators for Seismic Applications:
 1. Resilient Material Isolator Mounts, Seismic:
 - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
 2. Spring Isolator Hangers, Seismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

2.4 ACOUSTICAL AND VIBRATION ISOLATORS

- A. General Requirements:
 1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

2.5 SEISMIC RESTRAINT SYSTEMS

- A. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- B. Cable Restraints:
 1. Comply with ASCE 19.
 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
 4. Use protective thimbles for cable loops where potential for cable damage exists.
- C. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 CODE-REQUIRED SPECIAL INSPECTIONS

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 01 45 33 and statement of

- special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
 - 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 - 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
 - C. Seismic special inspections include, but are not limited to:
 - 1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with the certificate of compliance.
 - 2. Verification of required clearances between HVAC equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.
 - D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
 - E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
 - 1. Vibration-Isolated Equipment Support Bases:
 - a. Provide specified minimum clearance beneath base.
 - 2. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.
 - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
 - 3. Isolator Hangers:
 - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
 - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
 - 4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
 - 5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.

6. Adjust isolators to be free of isolation short circuits during normal operation.
 7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
- F. Seismic Controls:
1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris, or other obstructions.
 2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
 3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
 4. Equipment with Sheet Metal Housings:
 - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
 - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
 - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
 5. Concrete Housekeeping Pads:
 - a. Size in accordance with seismic design to meet anchor requirements.
 - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
 6. Seismic Restraint Systems:
 - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
 - b. Install restraints within permissible angles in accordance with seismic design.
 - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
 - d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
 - e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Vibration Isolation Systems:
 1. Verify isolator static deflections.
 2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- D. Seismic Controls:
 1. Verify snubbing element air gaps.
- E. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Ceiling tacks.

1.2 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2017.

1.3 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. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS**2.1 IDENTIFICATION APPLICATIONS**

- A. Air Handling Units: Nameplates.
- B. Air Terminal Units: Tags.
- C. Automatic Controls: Tags. Key to control schematic.
- D. Control Panels: Nameplates.
- E. Dampers: Ceiling tacks, where located above lay-in ceiling.
- F. Heat Transfer Equipment: Nameplates.
- G. Major Control Components: Nameplates.
- H. Pumps: Nameplates.
- I. Small-sized Equipment: Tags.
- J. Tanks: Nameplates.
- K. Thermostats: Nameplates.
- L. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.2 NAMEPLATES

- A. Manufacturers:
 - 1. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 3. Seton Identification Products, a Tricor Direct Company: www.seton.com/#sle.
- B. Letter Color: White.
- C. Letter Height: 1/4 inch.
- D. Background Color: Black.
- E. Plastic: Comply with ASTM D709.

2.3 TAGS

- A. Manufacturers:

1. Brimar Industries, Inc: www.pipemarker.com/#sle.
 2. Seton Identification Products, a Tricor Company: www.seton.com/#sle.
 3. Hanply.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.4 PIPE MARKERS

- A. Manufacturers:
1. Brady Corporation: www.bradycorp.com/#sle.
 2. Seton Identification Products, a Tricor Company: www.seton.com/#sle.
- B. Color: Conform to ASME A13.1. Follow WWU standards for label background and lettering colors for all piping types.
- C. 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.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

2.5 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 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. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

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

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.
- D. Commissioning activities.

1.2 RELATED REQUIREMENTS

- A. Section 01 91 13 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.
- B. Section 23 08 00 - Commissioning of HVAC.

1.3 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008, with Errata (2019).
- C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems 2015, with Errata (2017).
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing 2002.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Installer 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 to the Commissioning Authority.
 - 3. Include certification that the plan developer has reviewed 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. 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.
 - b. 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.
 - c. Identification and types of measurement instruments to be used and their most recent calibration date.
 - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.
 - f. 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.
- g. Expected problems and solutions, etc.
- h. Details of how TOTAL flow will be determined; for example:
 - 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.
 - 2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
- i. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
- j. Confirmation of understanding of the outside air ventilation criteria under all conditions.
- k. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
- l. Method of checking building static and exhaust fan and/or relief damper capacity.
- m. Methods for making coil or other system plant capacity measurements, if specified.
- n. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
- o. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
- p. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Field Logs: Submit at least twice a week to the Commissioning Authority.
- 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. 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 the Commissioning Authority 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. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 6. Units of Measure: Report data in I-P (inch-pound) units only.
- G. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION****3.1 GENERAL REQUIREMENTS**

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 - 2. SMACNA (TAB).
- 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.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
 - b. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 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. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.

3.4 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 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.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.5 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 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.

3.6 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. Units with VFDs shall operate at 60 Hz with final sheaves per WWU campus standards.
- 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 0.05 inches positive static pressure near the building entries.
- M. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- N. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.7 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.8 COMMISSIONING

- A. See Sections 01 91 13 - General Commissioning Requirements and 23 08 00 for additional requirements.
- B. Perform prerequisites prior to starting commissioning activities.
- C. Fill out Prefunctional Checklists for:
 - 1. Air side systems.
 - 2. Water side systems.
- D. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
- E. Re-check a random sample equivalent to 15 percent of the final TAB report data as directed by Commissioning Authority.
 - 1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
 - 2. Use the same test instruments as used in the original TAB work.
 - 3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
 - 4. For purposes of re-check, failure is defined as follows:
 - a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
 - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control,

- deviation of more than 30 percent at intermediate supply flow.
- c. Temperatures: Deviation of more than one degree F.
- d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
- e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
- 5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- F. In the presence of the Commissioning Authority, verify that:
 - 1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
 - 2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
 - 3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.9 SCOPE

- A. Test, adjust, and balance the following:
 - 1. Electric Heaters.
 - 2. Plumbing Pumps.
 - 3. HVAC Pumps.
 - 4. Heating Water System.
 - 5. Air Cooled Refrigerant Condensers.
 - 6. Packaged Roof Top Heating/Cooling Units.
 - 7. Air Coils.
 - 8. Terminal Heat Transfer Units.
 - 9. Air Handling Units.
 - 10. Fans.
 - 11. Air Filters.
 - 12. Air Terminal Units.
 - 13. Air Inlets and Outlets.

3.10 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. Pumps:
 1. Identification/number.
 2. Manufacturer.
 3. Size/model.
 4. Impeller.
 5. Service.
 6. Design flow rate, pressure drop, BHP.
 7. Actual flow rate, pressure drop, BHP.
 8. Discharge pressure.
 9. Suction pressure.
 10. Total operating head pressure.
 11. Shut off, discharge and suction pressures.
 12. Shut off, total head pressure.
- C. Combustion Equipment:
 1. Model number.
 2. Serial number.
 3. Firing rate.
 4. Heat input.
 5. Percent carbon monoxide (CO).
 6. Percent combustion efficiency.
 7. Heat output.
- D. Air Cooled Condensers:
 1. Identification/number.
 2. Location.
 3. Manufacturer.
 4. Model number.
 5. Serial number.
 6. Entering DB air temperature, design and actual.
 7. Leaving DB air temperature, design and actual.
 8. Number of compressors.
- E. Cooling Coils:
 1. Identification/number.
 2. Location.
 3. Service.
 4. Manufacturer.
 5. Air flow, design and actual.
 6. Entering air DB temperature, design and actual.
 7. Entering air WB temperature, design and actual.
 8. Leaving air DB temperature, design and actual.
 9. Leaving air WB temperature, design and actual.
 10. Water flow, design and actual.

11. Water pressure drop, design and actual.
 12. Entering water temperature, design and actual.
 13. Leaving water temperature, design and actual.
 14. Saturated suction temperature, design and actual.
 15. Air pressure drop, design and actual.
- F. Heating Coils:
1. Identification/number.
 2. Location.
 3. Service.
 4. Manufacturer.
 5. Air flow, design and actual.
 6. Water flow, design and actual.
 7. Water pressure drop, design and actual.
 8. Entering water temperature, design and actual.
 9. Leaving water temperature, design and actual.
 10. Entering air temperature, design and actual.
 11. Leaving air temperature, design and actual.
 12. Air pressure drop, design and actual.
- G. Electric Heaters:
1. Manufacturer.
 2. Identification/number.
 3. Location.
 4. Model number.
 5. Design kW.
 6. Number of stages.
 7. Phase, voltage, amperage.
 8. Test voltage (each phase).
- H. 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.
- I. 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.
- J. Exhaust Fans:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Air flow, specified and actual.
 6. Total static pressure (total external), specified and actual.
 7. Inlet pressure.
 8. Discharge pressure.
 9. Sheave Make/Size/Bore.
 10. Number of Belts/Make/Size.
 11. Fan RPM.
- K. 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.
- L. 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.
- M. Terminal Unit Data:
 1. Manufacturer.
 2. Type, constant, variable, single, dual duct.
 3. Identification/number.
 4. Location.
 5. Model number.
 6. Size.
 7. Minimum static pressure.
 8. Minimum design air flow.
 9. Maximum design air flow.
 10. Maximum actual air flow.
 11. Inlet static pressure.
- N. 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.

END OF SECTION

**SECTION 23 07 13
DUCT INSULATION**

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Duct insulation.
- B. Duct liner.
- C. Insulation jackets.
- D. Fire Rated Duct Wrap.

1.2 RELATED REQUIREMENTS

- A. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- B. Section 23 31 00 - HVAC Ducts and Casings: Glass fiber ducts.

1.3 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.
- C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2020a.
- D. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022.
- H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.
- I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 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.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS**2.1 REGULATORY REQUIREMENTS**

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
 - 1. Johns Manville: www.jm.com/#sle.
 - 2. Knauf Insulation; Atmosphere Duct Wrap: www.knaufinsulation.com/#sle.
 - 3. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. K value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 1200 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- 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.

2.3 GLASS FIBER, RIGID

- A. Manufacturer:
 - 1. Johns Manville: www.jm.com/#sle.
 - 2. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 3. Owens Corning Corporation; 700 Series FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
 - 1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 450 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent.
 - 4. 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.

2.4 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
 - 1. Armacell LLC: www.armacell.us/#sle.
 - 2. K-Flex USA LLC; Insul-Sheet: www.kflexusa.com/#sle.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
 - 1. Minimum Service Temperature: Minus 40 degrees F.
 - 2. Maximum Service Temperature: 180 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.

2.5 JACKETS

- A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
- B. Aluminum Jacket: ASTM B209/B209M.
 - 1. Thickness: 0.016 inch sheet.
 - 2. Finish: Smooth.
 - 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.

2.6 DUCT LINER

- A. Manufacturers:
 - 1. Armacell LLC; AP Coilflex: www.armacell.us/#sle.
 - 2. Johns Manville: www.jm.com/#sle.
 - 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Elastomeric Foam Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
 - 1. Minimum Service Temperature: Minus 40 degrees F.
 - 2. Maximum Service Temperature: 180 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.

2.7 FIRE RATED DUCT WRAP

- A. Type I Kitchen Hood Grease Exhaust Ducts: Provide 3M Fire Barrier duct wrap 615+, compliant with UL1978, AC101 and ASTM 2336, foil encapsulated.

PART 3 EXECUTION**3.1 EXAMINATION**

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Insulate all ductwork per Oregon energy code requirements.
- B. Install in accordance with manufacturer's instructions and Oregon energy code requirements.
- C. Install in accordance with NAIMA National Insulation Standards.
- D. Insulated Ducts Conveying Air Below Ambient Temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- E. Insulated 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.
- F. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

- G. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.
- H. Slope exterior ductwork to shed water.
- I. External Duct Insulation Application:
 - 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 - 2. Secure insulation without vapor barrier with staples, tape, or wires.
 - 3. Install without sag on underside of duct. Use adhesive or 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.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- J. Duct and Plenum Liner Application:
 - 1. Adhere insulation with adhesive for 90 percent coverage.
 - 2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) 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.

END OF SECTION

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Piping insulation.
- B. Jackets and accessories.
- C. Engineered wall outlet seals and refrigerant piping insulation protection.

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.
- C. Section 23 22 13 - Steam and Condensate Heating Piping: Placement of hangers and hanger inserts.

1.3 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2019.
- C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.
- D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019.
- E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement 2007 (Reapproved 2019).
- F. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement 2007 (Reapproved 2019).
- G. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2020a.
- H. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2022a.
- I. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2018).
- J. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces 2008 (Reapproved 2019).
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022.
- M. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials 2013 (Reapproved 2021).
- N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.6 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS**2.1 REGULATORY REQUIREMENTS**

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, RIGID

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville Corporation: www.jm.com/#sle.
 - 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
 - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 650 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- F. Vapor Barrier Lap Adhesive: Compatible with insulation.
- G. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- H. Fibrous Glass Fabric:
 - 1. Cloth: Untreated; 9 oz/sq yd weight.
 - 2. Blanket: 1.0 lb/cu ft density.
- I. Indoor Vapor Barrier Finish:
 - 1. Cloth: Untreated; 9 oz/sq yd weight.
 - 2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- J. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- K. Insulating Cement: ASTM C449.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
 - 1. Aeroflex USA, Inc: www.aeroflexusa.com/#sle.
 - 2. Armacell LLC; ArmaFlex Ultra with FlameDefense: www.armacell.us/#sle.

3. K-Flex USA LLC; K-Flex Titan: www.kflexusa.com/#sle.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
 1. Minimum Service Temperature: Minus 40 degrees F.
 2. Maximum Service Temperature: 180 degrees F.
 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.4 JACKETS

- A. PVC Plastic.
 1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com/#sle.
 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: 10 mil.
 - e. Connections: Brush on welding adhesive.
- B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
- C. Aluminum Jacket: ASTM B209/B209M formed aluminum sheet.
 1. Thickness: 0.016 inch sheet.
 2. Finish: Smooth.
 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.
- 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; 0.010 inch thick stainless steel.

2.5 ENGINEERED WALL OUTLET SEALS AND REFRIGERANT PIPING INSULATION PROTECTION

- A. Insulation Protection System: Refrigerant piping insulation PVC protective cover.
 1. PVC Insulation Cover Color: Black with full-length velcro fastener.
 2. Weatherization and Ultraviolet Exposure Protection: Comply with ASTM G153.
 3. Water/Vapor Permeability: Comply with ASTM E96/E96M.
 4. Flame Spread and Smoke Development Rating of 24/450: Comply with ASTM E84 or UL 723.

2.6 ACCESSORIES

- A. General Requirements:
 1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
 2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.

3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
4. Supply materials that are asbestos free.
- B. Corrosion Inhibitors:
 1. Corrosion Control Gel:
 - a. Corrosion Protection: Comply with ASTM B117 and ASTM D610.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

- A. Insulate all piping per Oregon energy code requirements.
- B. Install in accordance with manufacturer's instructions and Oregon energy code requirements.
- C. Install in accordance with NAIMA National Insulation Standards.
- D. Insulated Pipes Conveying Fluids Below Ambient Temperature:
 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:
 1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. 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.
- G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- H. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
 1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- I. 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.
- J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 84 00.

- K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.
- L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.
- M. Buried Piping: Provide factory-fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.
- N. 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.

END OF SECTION

SECTION 23 08 00
COMMISSIONING OF HVAC

PART 1 GENERAL**1.1 SUMMARY**

- A. See Section 01 91 13 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 01 91 13.
- B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- C. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- D. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
 - 1. Control system.
 - 2. Piping systems and equipment.
 - 3. Terminal units.
 - 4. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.
- E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.2 REFERENCE STANDARDS

- A. ASHRAE Guideline 1.1 - HVAC&R Technical Requirements for the Commissioning Process 2007, with Errata (2012).

1.3 SUBMITTALS

- A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.
- B. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.
- C. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
 - 1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
 - 2. Full as-built set of control drawings.
 - 3. Full as-built sequence of operations for each piece of equipment.
 - 4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
 - a. Floor.
 - b. Room number.
 - c. Room name.
 - d. Air handler unit ID.

- e. Reference drawing number.
- f. Air terminal unit tag ID.
- g. Heating and/or cooling valve tag ID.
- h. Minimum air flow rate.
- i. Maximum air flow rate.
- 5. Full print out of all schedules and set points after testing and acceptance of the system.
- 6. Full as-built print out of software program.
- 7. Electronic copy on disk of the entire program for this facility.
- 8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
- 9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
- 10. Control equipment component submittals, parts lists, etc.
- 11. Warranty requirements.
- 12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
- 13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
 - a. Sequences of operation.
 - b. Control drawings.
 - c. Points lists.
 - d. Controller and/or module data.
 - e. Thermostats and timers.
 - f. Sensors and DP switches.
 - g. Valves and valve actuators.
 - h. Dampers and damper actuators.
 - i. Program setups (software program printouts).
- D. Project Record Documents: See Section 01 78 00 for additional requirements.
 - 1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
 - 2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.
- E. Draft Training Plan: In addition to requirements specified in Section 01 79 00, include:
 - 1. Follow the recommendations of ASHRAE Guideline 1.1.
 - 2. Control system manufacturer's recommended training.
 - 3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.
- F. Training Manuals: See Section 01 79 00 for additional requirements.
 - 1. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will

NOT become the property of Owner.

- B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

PART 3 EXECUTION

3.1 PREPARATION

- A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.
- B. Furnish additional information requested by the Commissioning Authority.
- C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.
- D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.
- E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
- F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.
- G. Provide temperature and pressure taps in accordance with Contract Documents.

3.2 INSPECTING AND TESTING - GENERAL

- A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.
- B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.
- C. Provide two-way radios for use during the testing.
- D. Valve/Damper Stroke Setup and Check:
 - 1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 - 2. Set pump/fan to normal operating mode.
 - 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 - 4. Command valve/damper open; verify position is full open and adjust output signal as required.
 - 5. Command valve/damper to a few intermediate positions.
 - 6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- E. Isolation Valve or System Valve Leak Check: For valves not by coils.
 - 1. With full pressure in the system, command valve closed.
 - 2. Use an ultra-sonic flow meter to detect flow or leakage.

- F. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

3.3 TAB COORDINATION

- A. TAB: Testing, adjusting, and balancing of HVAC.
- B. Coordinate commissioning schedule with TAB schedule.
- C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
- D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.
- E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.
- F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

3.4 CONTROL SYSTEM FUNCTIONAL TESTING

- A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of Contract Documents and the detailed Sequences of Operation documentation submittal.
- B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with Contract Documents.
- C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.
- D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
 - 1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Owner.
 - 2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.
- E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
- F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
 - 1. Setpoint changing features and functions.
 - 2. Sensor calibrations.
- G. Demonstrate to the Commissioning Authority:
 - 1. That all specified functions and features are set up, debugged and fully operable.
 - 2. That scheduling features are fully functional and setup, including holidays.
 - 3. That all graphic screens and value readouts are completed.
 - 4. Correct date and time setting in central computer.
 - 5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining

- units at no extra cost to Owner.
6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
 7. Power failure and battery backup and power-up restart functions.
 8. Global commands features.
 9. Security and access codes.
 10. Occupant over-rides (manual, telephone, key, keypad, etc.).
 11. O&M schedules and alarms.
 12. Occupancy sensors and controls.
 13. All control strategies and sequences not tested during controlled equipment testing.
- H. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.5 OPERATION AND MAINTENANCE MANUALS

- A. See Section 01 78 00 for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.6 DEMONSTRATION AND TRAINING

- A. See Section 01 79 00 for additional requirements.
- B. Demonstrate operation and maintenance of HVAC system to Owner's personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
- D. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide the following minimum durations of training:
- E. TAB Review: Instruct Owner's personnel for minimum [] hours, after completion of TAB, on the following:
 1. Review final TAB report, explaining the layout and meanings of each data type.
 2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
 3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
 4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.

- 5. Other salient information that may be useful for facility operations, relative to TAB.
- F. Provide the services of manufacturer representatives to assist instructors where necessary.
- G. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION

SECTION 23 09 23
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. System description.
- B. Operator interface.
- C. Controllers.
- D. Power supplies and line filtering.

1.2 RELATED REQUIREMENTS

- A. Section 23 09 93 - Sequence of Operations for HVAC Controls.
- B. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.
- C. Section 01 91 13 - General Commissioning Requirements

1.3 REFERENCE STANDARDS

- A. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks 2020, with Errata and Amendments (2022).
- B. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests 2019h.
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL (DIR) - Online Certifications Directory Current Edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for each system component and software module.
- C. Shop Drawings:
 - 1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
 - 2. List connected data points, including connected control unit and input device.
 - 3. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
 - 4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - 5. Indicate description and sequence of operation of operating, user, and application software.
- D. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
 - 2. Include submittals data in final "Record Documents" form.
- E. Operation and Maintenance Data:
 - 1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.

2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
 3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 70.
- B. Designer Qualifications: Perform design of system using manufacturer's software under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- D. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.
- E. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Substantial Completion.
- C. Provide five year manufacturer's warranty for field programmable micro-processor based units.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Johnson Controls Branch Office; [____]: www.johnsoncontrols.com/#sle.
- B. Northwest Controls Contractors
- C. Albireo

2.2 SYSTEM DESCRIPTION

- A. Provide JCI Metasys control system using field programmable micro-processor based units. Tie into existing district/building network, and provide graphics in the UI on the central and match existing standard seamlessly. Match existing district naming conventions and standards.
- B. Existing school systems utilize N2 communication bus which should be utilized for new work.
- C. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
- D. Include operator input/output devices, control units, local area networks (LAN), sensors, control devices, and actuators as necessary.
- E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
- F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

2.3 CONTROLLERS

- A. Application Specific Controllers:
 1. General:

- a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
 - b. Customized for operation within the confines of equipment served.
 - c. Communication with other network devices to be based on assigned protocol.
- 2. Communication:
 - a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
 - b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
- 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
- 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
- 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
- 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.
- B. Input/Output Interface:
 - 1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
 - 2. All Input/Output Points:
 - a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
 - b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
 - 3. Binary Inputs:
 - a. Allow monitoring of On/Off signals from remote devices.
 - b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
 - c. Sense dry contact closure with power provided only by the controller.
 - 4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
 - 5. Analog Inputs:

- a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
 - b. Compatible with and field configurable to commonly available sensing devices.
- 6. Binary Outputs:
 - a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
 - b. Outputs provided with three position (On/Off/Auto) override switches.
 - c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
- 7. Analog Outputs:
 - a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
 - b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
 - c. Drift to not exceed 0.4 percent of range per year.
- 8. System Object Capacity:
 - a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
 - b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

2.4 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies:
 - 1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
 - 2. Limit connected loads to 80 percent of rated capacity.
 - 3. Match DC power supply to current output and voltage requirements.
 - 4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
 - 5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
 - 6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
 - 7. Operational Ambient Conditions: 32 to 120 degrees F.
 - 8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
 - 9. Line voltage units UL recognized and CSA approved.
- B. Power Line Filtering:
 - 1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
 - 2. Minimum surge protection attributes:
 - a. Dielectric strength of 1000 volts minimum.
 - b. Response time of 10 nanoseconds or less.
 - c. Transverse mode noise attenuation of 65 dB or greater.
 - d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

2.5 LOCAL AREA NETWORK (LAN)

- A. Provide communication between control units over local area network (LAN).
- B. LAN Capacity: Not less than 60 stations or nodes.
- C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.
- D. LAN Data Speed: Minimum 19.2 Kb.
- E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.
- F. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
- G. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

PART 3 EXECUTION**3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.2 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 23 09 93.
- C. Provide conduit and electrical wiring in accordance with Section 26 05 83. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.3 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate complete and operating system to Owner.

END OF SECTION

SECTION 23 21 13
HYDRONIC PIPING

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Equipment drains and overflows.
- D. Pipe hangers and supports.
- E. Unions, flanges, and mechanical couplings.
- F. Valves:
 - 1. Ball valves.
 - 2. Check valves.
 - 3. Pressure independent temperature control valves and balancing valves.

1.2 RELATED REQUIREMENTS

- A. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.
- B. Section 23 05 23 - General-Duty Valves for HVAC Piping.
- C. Section 23 07 19 - HVAC Piping Insulation.
- D. Section 23 25 00 - HVAC Water Treatment: Pipe cleaning.

1.3 REFERENCE STANDARDS

- A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.
- B. ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250 2018.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2021.
- E. ASME B16.34 - Valves — Flanged, Threaded, and Welding End 2020.
- F. ASME B31.9 - Building Services Piping 2020.
- G. ASTM B32 - Standard Specification for Solder Metal 2020.
- H. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2022.
- I. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.
- J. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 2021a.
- K. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) 2020.
- L. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 2021.
- M. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 2020.
- N. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets 2020.
- O. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers 1992, with Editorial Revision (2018).
- P. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
 - 2. Provide manufacturers catalog information.
 - 3. Indicate valve data and ratings.
- C. Project Record Documents: Record actual locations of valves.
- D. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- E. 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: One for each type and size of valve.

1.5 QUALITY ASSURANCE

- A. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.
- B. Date stamp all castings used for coupling housings, fittings, valve bodies, etc. for quality assurance and traceability.
- C. Coupling Manufacturer:
 - 1. Perform on-site training by factory-trained representative to the Contractor's field personnel in the proper use of grooving tools and installation of grooved joint products.
 - 2. Periodic job site visits by factory-trained representative to ensure best practices in grooved joint installation.

1.6 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.

PART 2 PRODUCTS**2.1 HYDRONIC SYSTEM REQUIREMENTS**

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
 - 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 - 2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
 - 3. Grooved mechanical joints may be used in accessible locations only.
 - a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
 - b. Use rigid joints unless otherwise indicated.
 - 4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

D. Valves: Provide valves where indicated:

1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.
2. For shut-off and to isolate parts of systems or vertical risers, use gate or ball valves.

2.2 HEATING WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn, using one of the following joint types:

1. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.
 - a. Manufacturers:
 - 1) Viega LLC: www.viega.us/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types:

1. Threaded Joints: Galvanized cast iron, or ASME B16.3 malleable iron fittings.

B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

C. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.

1. Fittings: ASTM D2466 or D2467, PVC.
2. Joints: Solvent welded in accordance with ASTM D2855.

2.4 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 Inches and Greater: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 Inches and Greater: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
8. Wall Support for Pipe Sizes 4 Inches and Greater: Welded steel bracket and wrought steel clamp.
9. Wall Support for Hot Pipe Sizes 6 Inches and Greater: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
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.

2.5 UNIONS, FLANGES, AND MECHANICAL COUPLINGS

A. Unions for Pipe of 2 Inches and Less:

1. Ferrous Piping: 150 psi brass or malleable iron, threaded.

2. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe 2 Inches and Greater:
 1. Ferrous Piping: 150 psig forged steel, slip-on.
 2. Copper Piping: Bronze.

2.6 PRESSURE INDEPENDENT TEMPERATURE CONTROL VALVES AND BALANCING VALVES

- A. Control Valves: Factory-fabricated pressure independent with internal differential pressure regulator (DPRV), which automatically adjusts to normal changes in system pressure and provides 100 percent control valve authority at all positions of the valve.
 1. Maintain proportional and linear flow coil characteristics.
 2. PICV to accurately control the flow from 0 to 100 percent full rated flow with an operating pressure differential range of 3 to 60 psig.
 3. Provide control valve to incorporate control, balancing, and flow limiting. Hydronic system pressure independent control valve bodies to comply with ASME B16.34 or ASME B16.15 pressure and temperature class ratings based on the design operating temperature and 150 percent of the system design operating pressure and have the following characteristics:
 - a. 2 NPS and Smaller: Class 150 bronze or brass body with union connections, stainless steel trim, stainless steel rising stem, stainless steel disc or ball, and screwed ends with backseating capacity repackable under pressure.
 - b. 2-1/2 NPS and Larger: Class 125 iron or ductile iron body, stainless steel trim, stainless steel rising stem, stainless steel disc or ball, flanged ends with backseating capacity repackable under pressure.
 - c. Pressure Control Seat: Brass construction with vulcanized EPDM.
 - d. Fittings and Components: All fittings and components to meet ANSI standards and be compatible with readily available components. 8-inch valves and above to be provided with proper companion flanges.
 - e. Close-Off (Differential) Pressure Rating: Combination of actuator, DPRV action, and trim to provide a minimum close-off pressure rating of 150 percent of total system (pump) head. Provide actuator from the same manufacturer as the pressure independent control valve.
- B. Electronic Actuators: Direct-mounted, self-calibrating type designed for minimum 60,000 full-stroke cycles at rated force.
- C. Provide actuator with visible position indication. Fail positions on power failure to include in-place, open or closed as indicated in the controls specifications.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment using jointing system specified.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. After completion, fill, clean, and treat systems. See Section 23 25 00 for additional requirements.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Pressure testing:
 - 1. Test all hydronic piping using water at 150 psi for at least 4 hours.
 - 2. Test all refrigerant piping using nitrogen at 450 psi for at least 24 hours.
- C. Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9 requirements.
- D. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- E. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- F. Install piping to conserve building space and to avoid interference with use of space.
- G. Group piping whenever practical at common elevations.
- H. Sleeve pipe passing through partitions, walls, and floors.
- I. Slope piping and arrange to drain at low points.
- J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 23 05 16.
 - 1. Flexible couplings may be used in header piping to accommodate thermal growth, thermal contraction in lieu of expansion loops.
 - 2. Use flexible couplings in expansion loops.
- K. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
 - 2. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches of each horizontal elbow.
 - 4. Use hangers with 1-1/2 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5. Support vertical piping at every other 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.
- L. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.
- M. Install valves with stems upright or horizontal, not inverted.

END OF SECTION

SECTION 23 21 14
HYDRONIC SPECIALTIES

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Air vents.
- B. Air separators.
- C. Strainers.
- D. Balancing valves.
- E. Relief valves.
- F. Pressure reducing valves.

1.2 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping.

1.3 REFERENCE STANDARDS

- A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels 2021.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS**2.1 EXPANSION TANKS**

- A. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psi, with flexible EPDM diaphragm sealed into tank, and steel support stand.
- B. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check backflow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

2.2 AIR VENTS

- A. Manufacturers:
 - 1. Armstrong International, Inc: www.armstronginternational.com/#sle.
 - 2. ITT Bell & Gossett: www.bellgossett.com/#sle.
 - 3. Taco, Inc: www.taco-hvac.com/#sle.
- B. Manual Air Vent: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
- C. Float Air Vent:
 - 1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with

isolating valve.

D. Maximum Fluid Pressure: 150 psi.

E. Maximum Fluid Temperature: 250 degrees F.

2.3 AIR SEPARATORS

2.4 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc: www.armstronginternational.com/#sle.
2. Grinnell Products, a Tyco Business: www.grinnell.com/#sle.
3. The Metraflex Company; LPD Y Strainer: www.metraflex.com/#sle.
4. Titan Flow Control, Inc..

B. Size 2 inch and Under:

1. Provide threaded, grooved, or sweat brass or iron body for up to 175 psi working pressure, Y-pattern strainer with 1/32 inch stainless steel perforated screen.

2.5 SUCTION DIFFUSERS

A. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh startup screen, and permanent magnet located in flow stream and removable for cleaning.

2.6 PUMP CONNECTORS

2.7 BALANCING VALVES

A. Manufacturers:

1. Victaulic
2. Bell & Gossett, a brand of Xylem, Inc; [____]: www.bellgossett.com/#sle.

B. Size 2 inch and Smaller:

1. Metal construction materials consist of bronze or brass.
2. Non-metal construction materials consist of EPDM.

C. Size 2-1/2 inch and Larger:

1. Valve body construction materials consist of ductile iron.
2. Internal components construction materials consist of EPDM.

2.8 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.9 PRESSURE REDUCING VALVES

A. Manufacturers:

1. Bell & Gossett, a brand of Xylem, Inc; [____]: www.bellgossett.com/#sle.

B. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve. Refer to Section 23 21 13.

C. Materials of Construction:

1. Valve Body: Constructed of brass.
2. Internal Components: Construct of brass and engineered plastics.

D. Provide integral check valve and strainer.

E. Maximum Inlet Pressure: 125 psi.

F. Maximum Fluid Temperature: 225 degrees F.

G. Adjustable Pressure Range: From 10 to 45 psi, set to 25 psi.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. Install specialties in accordance with manufacturer's instructions.
- B. Where large air quantities can accumulate, provide enlarged air collection standpipes.
- C. Provide manual air vents at system high points and as indicated.
- D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- E. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- F. Provide valved drain and hose connection on strainer blowdown connection.
- G. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- H. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- I. Pipe relief valve outlet to nearest floor drain.
- J. Where one line vents several relief valves, make cross-sectional area equal to sum of individual vent areas.

END OF SECTION

SECTION 23 25 00
HVAC WATER TREATMENT

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Materials.
 - 1. System cleaner.
 - 2. Closed system treatment (water).

1.2 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping.
- B. Section 23 21 14 - Hydronic Specialties.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.

PART 2 PRODUCTS**2.1 MATERIALS**

- A. System Cleaner:
 - 1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodiumtripoly phosphate and sodium molybdate.
 - 2. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite or microbiocides such as quarternary ammonia compounds, tributyltin oxide, methylene bis (thiocyanate).
- B. Closed System Treatment (Water):
 - 1. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
 - 2. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.

PART 3 EXECUTION**3.1 PREPARATION**

- A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- B. Place terminal control valves in open position during cleaning.
- C. Verify that electric power is available and of the correct characteristics.

3.2 CLEANING SEQUENCE

- A. Concentration:
 - 1. As recommended by manufacturer.
- B. Hot Water Heating Systems:
 - 1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
 - 2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
 - 3. Circulate for 6 hours at design temperatures, then drain.

4. Refill with clean water and repeat until system cleaner is removed.
- C. Flush open systems and glycol filled closed systems with clean water for one hour minimum. Drain completely and refill.
- D. Remove, clean, and replace strainer screens.
- E. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.4 CLOSED SYSTEM TREATMENT

- A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.
- B. Introduce closed system treatment through bypass feeder when required or indicated by test.

3.5 CLOSEOUT ACTIVITIES

- A. Training: Train Owner's personnel on operation and maintenance of chemical treatment system.
 1. Provide minimum of two hours of instruction for two people.
 2. Have operation and maintenance data prepared and available for review during training.
 3. Conduct training using actual equipment after treated system has been put into full operation.

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Metal ductwork.
- B. Duct cleaning.

1.2 RELATED REQUIREMENTS

- A. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- B. Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- C. Section 23 33 00 - Air Duct Accessories.
- D. Section 23 37 00 - Air Outlets and Inlets.

1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 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, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.
- 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 2018a.
- F. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- H. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.
- I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.
- J. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines 2001.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for duct materials.
- C. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.5 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.
- C. Deliver all supply ductwork to the job site sealed per the WWU Construction Standards.

PART 2 PRODUCTS**2.1 DUCT ASSEMBLIES**

- A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.
- B. Ducts: Galvanized steel, unless otherwise indicated.
- C. Low Pressure Supply (Heating Systems): 1 inch wg pressure class, galvanized steel.
- D. Low Pressure Supply (System with Cooling Coils): 1 inch wg pressure class, galvanized steel.
- E. Medium and High Pressure Supply: 3 inch w.g. pressure class, galvanized steel.
- F. Return and Relief: 1 inch wg pressure class, galvanized steel.
- G. General Exhaust: 1/2 inch wg pressure class, galvanized steel.
- H. Kitchen Cooking Hood Exhaust: 2 inch wg pressure class.
 - 1. Construct of 16 gauge, 0.0598 inch sheet steel using continuous external welded joints in rectangular sections.
- I. Dishwasher Exhaust: 1 inch wg pressure class, stainless steel.
 - 1. Construct of 18 gauge, 0.0500 inch stainless steel using continuous external welded joints in rectangular sections.
- J. Grease Exhaust: 2 inch wg pressure class, un-galvanized steel.
 - 1. Construct of 16 gauge un-galvanized steel.
 - 2. Construction:
 - a. Provide fire rated duct wrap for entire extent of Type I kitchen hood exhaust ductwork.
 - b. Liquidtight with continuous external weld for all seams and joints.
 - c. Where ducts are not self draining back to equipment, provide low point drain pocket with copper drain pipe to sanitary sewer.
 - 3. Access Doors:
 - a. Provide for duct cleaning inside horizontal duct at drain pockets, every 20 feet and at each change of direction.
 - b. Use same material and thickness as duct with gaskets and sealants rated 1500 degrees F for grease tight construction.
- K. Outside Air Intake: 1/2 inch wg pressure class, galvanized steel.
- L. Combustion Air: 1/2 inch w.g. pressure class.
- M. Transfer Air and Sound Boots: 1/2 inch wg pressure class, sheet metal with 1" duct liner.

2.2 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Un-Galvanized Steel for Ducts: ASTM A1008/A1008M Designation CS (commercial steel), cold-rolled.
- C. Aluminum for Ducts: ASTM B209/B209M; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.
- D. Stainless Steel for Ducts: ASTM A666, Type 304.
- E. 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 index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
- 4. For Use with Flexible Ducts: UL labeled.
- F. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.3 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
- B. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- C. 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.
- D. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
- E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- F. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).
- G. 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.

2.4 MANUFACTURED DUCTWORK AND FITTINGS

- A. Spiral Ducts: Round spiral lockseam duct with galvanized steel outer wall.
 - 1. Manufacture in accordance with SMACNA (DCS).
- B. Round Ducts: Round lockseam duct with galvanized steel outer wall.
 - 1. Manufacture in accordance with SMACNA (DCS).
- C. Round Duct Connection System: Interlocking duct connection system in accordance with SMACNA (DCS).
- D. Kitchen Hood and Grease Exhaust Ducts:
 - 1. Fabricate in accordance with ductwork manufacturer's instructions, SMACNA (DCS), SMACNA (KVS), and NFPA 96.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Outdoor/rooftop ductwork cover:
 - 1. Install insulation in conformance with manufacturer's recommendations and requirements.
- C. Outdoor Duct Exposed to Weather:
 - 1. Install ductwork jacket with brakes/slope to prevent standing water on duct, and use all weatherable components.
 - 2. Insulate per Oregon energy code requirements (minimum R-8).
 - 3. Provide weatherproof seal at all joints and seams, with a minimum 2-inch overlap.
 - 4. Label jacket every 6-feet and within 2-feet of building penetrations and equipment connections: "Do not stand or place equipment on ductwork."
- D. Ductwork Pressure Testing:

1. Test all medium pressure ductwork (upstream of terminal units) associated with the units being replaced during this project.
 2. Randomly test three sections of low pressure ductwork for each air handler.
 3. All ductwork testing shall be conducted in accordance with the latest published version of the SMACNA HVAC Air Duct Leakage Test Manual.
- E. Install in accordance with manufacturer's instructions, and insulate per Oregon energy code requirements.
- F. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- 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. Connect terminal units to supply ducts. Do not use flexible duct to change direction.
- K. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.
- L. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

3.2 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.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Air turning devices/extractors.
- B. Combination fire and smoke dampers.
- C. Duct access doors.
- D. Duct test holes.
- E. Fire dampers.
- F. Flexible duct connectors.
- G. Volume control dampers.

1.2 RELATED REQUIREMENTS

- A. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- B. Section 23 31 00 - HVAC Ducts and Casings.

1.3 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating 2018.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
- C. NFPA 92 - Standard for Smoke Control Systems 2021.
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.
- E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service Current Edition, Including All Revisions.
- F. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances Current Edition, Including All Revisions.
- G. UL 555 - Standard for Fire Dampers Current Edition, Including All Revisions.
- H. UL 555S - Standard for Smoke Dampers Current Edition, Including All Revisions.
- I. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces Current Edition, Including All Revisions.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS**2.1 BACKDRAFT DAMPERS - METAL**

- A. Manufacturers:
 - 1. Nailor Industries, Inc: www.nailor.com/#sle.
 - 2. Ruskin Company, a brand of Johnson Controls: www.ruskin.com/#sle.

- B. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

2.2 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
 - 1. Nailor Industries, Inc: www.nailor.com/#sle.
 - 2. Pottorff: www.pottorff.com/#sle.
 - 3. Ruskin Company, a brand of Johnson Controls: www.ruskin.com/#sle.
 - 4. Greenheck.
- B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
- C. Provide factory sleeve and collar for each damper.
- D. Multiple Blade Dampers: Fabricate with 16 gauge, 0.0598 inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch actuator shaft.
- E. Operators: UL listed and labelled spring return electric type suitable for 120 volts, single phase, 60 Hz. Locate damper operator on interior of duct and link to damper operating shaft.

2.3 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Acudor Products Inc, a Division of Nelson Industrial Inc: www.acudor.com/#sle.
 - 2. Elgen Manufacturing, Inc: www.elgenmfg.com/#sle.
 - 3. Nailor Industries, Inc: www.nailor.com/#sle.
 - 4. Ruskin Company, a brand of Johnson Controls: www.ruskin.com/#sle.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.

2.4 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.

2.5 FIRE DAMPERS

- A. Manufacturers:
 - 1. Nailor Industries, Inc: www.nailor.com/#sle.
 - 2. Pottorff: www.pottorff.com/#sle.
 - 3. Ruskin Company: www.ruskin.com/#sle.
 - 4. Greenheck .
- B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- C. Horizontal Dampers: Galvanized steel, 22 gauge, 0.0299 inch frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
- D. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.
- E. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.6 FLEXIBLE DUCT CONNECTORS

- A. Manufacturers:
 - 1. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.

2. Duro Dyne.
3. Thermaflex
- B. Fabricate in accordance with SMACNA (DCS) 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 2 inches wide.
 2. Metal: 3 inches wide, 24 gauge, 0.0239 inch 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.

2.7 VOLUME CONTROL DAMPERS

- A. Manufacturers:
 1. Nailor Industries, Inc: www.nailor.com/#sle.
 2. Ruskin Company, a brand of Johnson Controls: www.ruskin.com/#sle.
 3. Rossi Hardware Everlock.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Single Blade Dampers:
 1. Fabricate for duct sizes up to 6 by 30 inch.
 2. Blade: 24 gauge, 0.0239 inch, minimum.
- D. Constant Airflow Regulators:
 1. General Requirements:
 - a. Provide bi-directional, air balancing regulator for pressure independent air volume control.
 - b. Complies with UL 2043 for heat and smoke release.
 - c. Complies with AMCA 500-D for the allowable leakage rates.
 - d. Airflow regulator to be field adjustable.
 2. Construction:
 - a. Nominal Diameter: 4 inch.
 - b. Frame: Thermoplastic resin in compliance with UL 94.
 - c. Blade: Thermoplastic resin in compliance with UL 94.
 - d. Bearings: Hydraulic blade dampener.
 - e. Outer Seal: Removable rubber gasket-type around circumference of damper.
 - f. Spring: Stainless steel leaf-type.
 - g. Temperature Range: 25 degrees F to 150 degrees F .
 - h. Operating Range: 0.2 inch W.C. to 2.0 inch W.C..

PART 3 EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 31 00 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
- G. Demonstrate re-setting of fire dampers to Owner's representative.
- H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- J. 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.
- K. 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

SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Single-duct terminal units.
 - 1. Single-duct, variable-volume units.

1.2 RELATED REQUIREMENTS

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- C. Section 23 09 13 - Instrumentation and Control Devices for HVAC: Thermostats and actuators.
- D. Section 23 09 23 - Direct-Digital Control System for HVAC.
- E. Section 23 09 93 - Sequence of Operations for HVAC Controls.
- F. Section 23 21 13 - Hydronic Piping: Connections to heating coils.
- G. Section 23 21 14 - Hydronic Specialties: Connections to heating coils.
- H. Section 23 31 00 - HVAC Ducts and Casings.
- I. Section 23 33 00 - Air Duct Accessories.
- J. Section 23 37 00 - Air Outlets and Inlets.
- K. Section 23 82 00 - Convection Heating and Cooling Units: Air coils.
- L. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils 2001, with Addenda (2011).
- B. AHRI 880 (I-P) - Performance Rating of Air Terminals 2017.
- C. AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets 2008, with Addendum (2011).
- D. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size 2017, with Addendum (2022).
- E. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. ASHRAE Std 130 - Laboratory Methods of Testing Air Terminal Units 2016.
- G. ASTM A492 - Standard Specification for Stainless Steel Rope Wire 1995 (Reapproved 2019).
- H. ASTM A603 - Standard Specification for Metallic-Coated Steel Structural Wire Rope 2019.
- I. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material) 2019.
- J. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- K. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
- M. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems 2008.
- N. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors current edition, including all revisions.
- O. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
- E. Project Record Documents: Record actual locations of units and locations of access doors required for access of valving.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE**1.7 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for air terminal units.

PART 2 PRODUCTS**2.1 SINGLE-DUCT, VARIABLE-VOLUME UNITS**

- A. Manufacturers:
 - 1. Titus
 - 2. Metalaire, a brand of Metal Industries Inc: www.metalaire.com/#sle.
 - 3. Price Industries, Inc: www.priceindustries.com/#sle.
 - 4. Johnson Controls, Inc[<>]: www.johnsoncontrols.com/#sle.
 - 5. Nailor
- B. Basis of Design: Price Industries, Inc: www.priceindustries.com/#sle.
 - 1. Single-Duct Terminal Unit: SDV, (direct digital controls).
- C. General:
 - 1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
 - 2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.
- D. Unit Casing:
 - 1. Minimum 22 gauge, 0.0299 inch galvanized steel.

- a. Casing leakage to meet ASHRAE Std 130.
2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
3. Unit Discharge: Rectangular, with slip-and-drive connections.
4. Acceptable Liners:
 - a. 1/2 inch thick, coated, fibrous-glass complying with ASTM C1071.
 - 1) Secure with adhesive.
 - 2) Coat edges exposed to airstream with NFPA 90A approved sealant.
 - 3) Cover liner with non-porous foil.
 - b. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.
- E. Damper Assembly:
 1. Heavy-gauge, galvanized steel or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
 2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
 3. Incorporate low leak damper blades for tight airflow shutoff.
- F. Hot Water Heating Coil:
 1. Coil Casing: Minimum 22 gauge, 0.0299 inch galvanized steel, factory-installed on terminal discharge with rectangular outlet, duct connection type.
 2. Coil Fins: Aluminum or aluminum plated fins, mechanically-bonded to seamless copper tubes.
 3. Coil leak tested to minimum 350 psig.
 4. Base performance data on tests run in accordance with AHRI 410 and units to bear AHRI 410 label.
- G. Controls:
 1. DDC (Direct-Digital Controls):
 - a. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
 - b. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFM's.
 - 1) Occupied and unoccupied operating mode.
 - 2) Remote reset of temperature or CFM set points.
 - 3) Proportional, plus integral control of room temperature.
 - 4) Monitoring and adjusting with portable terminal.
 - c. Room Sensor:
 - 1) Compatible with temperature controls specified.
 - 2) Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
 2. Control Sequence:
 - a. Suitable for operation with duct pressures between 0.25 and 3.0 inch wg inlet static pressure.
 - b. Include factory-mounted and piped, 5-micron filter; and adjustable, velocity-resetting, high-limit control with amplifying relay.
 - c. See Section 23 09 93.

PART 3 EXECUTION**3.1 EXAMINATION**

- A. Verify that conditions are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.
- C. Provide ceiling access doors or locate units above easily removable ceiling components.
- D. Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See Section 23 0548.
- E. Do not support from ductwork.
- F. Connect to ductwork in accordance with Section 23 31 00.
- G. Provide minimum of 10 ft of 1 inch thick lined ductwork downstream of units.
- H. Install heating coils in accordance with Section 23 82 00.
- I. Verify that electric power is available and of the correct characteristics.

3.3 ADJUSTING

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to zero percent full flow. Set units with heating coils for minimum 50 percent full flow.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Provide manufacturer's field representative to inspect field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.
 - 1. Leak Test:
 - a. After installation, fill water coils and test for leaks.
 - b. Repair leaks and retest until no leaks exist.
 - 2. Operational Test:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Test and adjust controls and safeties.
 - c. Replace damaged and malfunctioning controls and other equipment.
 - d. Remove and replace malfunctioning units and retest as specified above.

3.5 CLEANING

- A. Install new filters.

END OF SECTION

SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Diffusers:
- B. Registers/grilles:
 - 1. Ceiling-mounted, exhaust and return register/grilles.
 - 2. Ceiling-mounted, supply register/grilles.
 - 3. Wall-mounted, supply register/grilles.
 - 4. Wall-mounted, exhaust and return register/grilles.
- C. Duct-mounted supply and return registers/louvers.
- D. Louvers:
- E. Roof hoods.
- F. Goosenecks.
- G. Gravity ventilators.

1.2 REFERENCE STANDARDS

- A. AHRI 880 (I-P) - Performance Rating of Air Terminals 2017.
- B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2012 (Reapproved 2015).
- C. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices 2021.
- D. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers 2022.
- E. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets 2006 (Reaffirmed 2021).
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.
- H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.
- I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
- J. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2021.
- K. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.
- L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

1.3 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.

1.4 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.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Krueger-HVAC, Division of Air System Components: www.krueger-hvac.com/#sle.
- B. Price Industries: www.price-hvac.com/#sle.
- C. Ruskin Company: www.ruskin.com/#sle.
- D. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com/#sle.
- E. Nailor.

2.2 DUCT-MOUNTED SUPPLY AND RETURN REGISTERS/LOUVERS

- A. Type: Duct-mounted, rectangular register for round-spiral duct with adjustable pivot-ended blades, end caps, built-in volume damper, and dual cover flanges to lay flush on duct surface regardless of diameter. Performance to match manufacturer's catalog data.
- B. Material: 22 gauge, 0.0299 inch.
 - 1. Provide crossing spiral fitting-body of matching duct diameter.
- C. Color: As selected by Architect from manufacturer's full range.

2.3 CEILING SUPPLY REGISTERS/GRILLES

- A. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- B. Construction: Made of aluminum extrusions with factory enamel finish.
- C. Color: As selected by Architect from manufacturer's full range.

2.4 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Frame: 1-1/4 inch margin with countersunk screw mounting.
- B. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
- C. Color: To be selected by Architect from manufacturer's standard range.

2.5 WALL SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical face, double deflection.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- C. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Color: To be selected by Architect from manufacturer's full range.

2.6 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, horizontal face.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting.
- C. Fabrication: Steel frames and blades, with factory baked enamel finish.
- D. Color: To be selected by Architect from manufacturer's full range.

2.7 LOUVERS

- A. Manufacturers:
 - 1. NCA, a brand of Metal Industries Inc: www.ncamfg.com/#sle.
 - 2. Ruskin Company: www.ruskin.com/#sle.
 - 3. Greenheck.

- B. Type: 4 inch deep frame with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/2 inch square mesh screen over intake or exhaust end.
- C. Fabrication: 12 gauge, 0.1046 inch (2.66 mm) thick extruded aluminum assembly, with factory mill finish.
- D. Color: To be selected by Architect from manufacturer's full range. Provide primed louver for painting by G.C.

2.8 GOOSENECKS

- A. Fabricate in accordance with of minimum 18 gauge, 0.0598 inch galvanized steel.
- B. Mount on minimum 12 inch high curb base where size exceeds 9 by 9 inch.

2.9 GRAVITY VENTILATORS

- A. Hood Intake and Relief Gravity Ventilator:
 - 1. General:
 - a. Low silhouette for intake and relief applications with natural gravity or negative pressure system(s).
 - b. Performance ratings and factory testing to be in accordance with AMCA 511 and AMCA 550.
 - c. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
 - 2. Hood and Base:
 - a. Material: Aluminum.
 - b. Hood Construction: Precision formed, arched panels with interlocking seams.
 - c. Vertical End Panels: Fully locked into hood end panels.
 - d. Curb Cap: Pre-punched mounting holes for installation.
 - 3. Birdscreen:
 - a. Fabricate in accordance with ASTM B221 (ASTM B221M).
 - b. Construction: 1/2 inch Galvanized mesh.
 - c. Horizontally mounted across hood intake area.
 - 4. Hood Support: Galvanized steel construction and fastened so hood can be removed completely from the base or hinged open.
 - 5. Options/Accessories:
 - a. Roof Curbs:
 - 1) Flat Roofs:
 - (a) Welded, straight side curb with flashing flange and wood nailer.
 - 2) Pitched Roofs: Welded, straight side curb with flashing flange and wood nailer.
 - 3) Material: Aluminum.
 - 4) Insulation Thickness: 1 inch.
 - b. Insect Screen:
 - 1) Fabricate in accordance with ASTM B221 (ASTM B221M).
 - 2) Construct of fine mesh aluminum.
 - 3) Fitted to top of the throat to prevent entry of insects.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.

- C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
- D. Install diffusers to ductwork with air tight connection.
- E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- F. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION

**SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL**

PART 1 GENERAL**1.01 DESCRIPTION**

- A The General and Supplementary Conditions are a part of the requirements for the work under this Division of the Specifications.

1.02 WORK INCLUDED

- A Provide labor and materials required to install, test and place into operation the electrical systems as called for in the Contract Documents, and in accordance with applicable codes and regulations.
- B Provide labor, materials, and accessories required to provide complete, operating electrical systems. Labor, materials or accessories not specifically called for in the Contract Documents, but required to provide complete, operating electrical systems shall be provided without additional cost to the Owner.

1.03 QUALITY ASSURANCE

- A Comply with the current applicable codes, ordinances, and regulations of the authority or authorities having jurisdiction, the rules, regulations and requirements of the utility companies serving the project and the Owner's insurance underwriter.
- B Drawings, specifications, codes and standards are minimum requirements. Where requirements differ, the most stringent apply.
- C Should any change in drawings or specifications be required to comply with governing regulations, notify the Architect prior to submitting bid.
- D All electrical equipment, materials, devices and installations shall meet or exceed minimum requirements of ADA, ANSI, ASTM, IEEE, IES, NEC, NEMA, NETA, NFPA, OSHA, SMACNA, UL, and the State Fire Marshal.
- E Execute work in strict accordance with the best practices of the trades in a thorough, substantial, workpersonlike manner by competent workpeople. Provide a competent, experienced, full-time Superintendent who is authorized to make decisions on behalf of the Contractor.
- F Equipment shall be certified for use in the State of the project and shall meet the State energy code.

1.04 ABBREVIATIONS AND DEFINITIONS

- A Abbreviations:
1. ADA Americans with Disabilities Act
 2. ANSI American National Standards Institute
 3. ASA Acoustical Society of America
 4. ASTM American Society for Testing and Materials
 5. BIL Basic Impulse Level
 6. CBM Certified Ballast Manufacturers
 7. ECC Engineer's Control Center
 8. EIA Electronic Industries Alliance
 9. ETL Electrical Testing Laboratories, Inc.
 10. FCC Fire Control Center
 11. FM Factory Mutual
 12. IEEE Institute of Electrical and Electronic Engineers
 13. IES Illuminating Engineering Society
 14. IPCEA International Power Cable Engineers Association

15. LED Light Emitting Diode
16. NEC National Electric Code
17. NEMA National Electrical Manufacturers Association
18. NETA National Electrical Testing Association
19. NFPA National Fire Protection Association
20. OEM Original Equipment Manufacturer
21. OSHA Occupational Safety and Health Administration
22. SCC Security Control Center
23. SMACNA Sheet Metal and Air Conditioning Contractors National Association
24. TIA Telecommunications Industry Association
25. UL Underwriters Laboratories

B Definitions:

1. Where it is stated in these specifications to submit to Engineer for review, refer to Architectural General and Supplementary Conditions for proper procedures.
2. FURNISH means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories and all other items customarily required for the proper and complete application.
3. INSTALL means to join, unit, fasten, link, attach, set up or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation.
4. PROVIDE means to FURNISH and INSTALL.
5. AS DIRECTED means as directed by the Architect, or the Architect's representative.
6. CONCEALED means embedded in masonry or other construction, installed behind wall furring or within drywall partitions, or installed within hung ceilings.
7. SUBMIT means submit to Architect for review.

1.05 GUARANTEE

- A** Submit a single guarantee stating that the work is in accordance with the Contract Documents. Guarantee work against faulty and improper material and workmanship for a period of one year from the date of final acceptance by the Owner, except that where guarantees or warranties for longer terms are provided or specified herein, the longer term shall apply. Correct any deficiencies, which occur during the guarantee period, within 24 hours of notification, without additional cost to the Owner, to the satisfaction of the Owner. Obtain similar guarantees from subcontractors, manufacturers, suppliers and subtrade specialists.

1.06 USE OF THE ARCHITECT'S AND ENGINEER'S DRAWINGS

- A** The Contractor shall obtain, at the Contractor's expense, from the Architect or Engineer a set of AutoCad or compatible format architectural and engineering drawings on electronic media where desired by the Contractor and/or required by the Specifications for use in preparing the shop drawings, coordination drawings, and record drawings. The Contractor shall provide to the Architect and Engineer a written release of liability acceptable to the Architect and Engineer prior to receiving the electronic media.

PART 2 PRODUCTS

2.01 EQUIPMENT AND MATERIALS

- A** Provide products and materials that are new, clean, free of defects, and free of damage and corrosion.
- B** Products and materials shall not contain asbestos, PCB, or any other material that is considered hazardous by the Environmental Protection Agency or any other authority having jurisdiction.
- C** Replace materials of less than specified quality and relocate work incorrectly installed as directed by the Architect at no additional cost to the Owner.

- D Provide name/data plates on major components of equipment with manufacturer's name, model number, serial number, capacity data and electrical characteristics attached in a conspicuous place.
- E Install materials and equipment with qualified trades people.
- F Maintain uniformity of manufacturer for equipment used in similar applications and sizes.
- G Fully lubricate equipment where required.
- H Follow manufacturer's instructions for installing, connecting, and adjusting equipment. Provide a copy of such instructions at the equipment during installation.
- I Where factory testing of equipment is required to ascertain performance, and attendance by the Owner's representative is required to witness such tests, associated travel costs and subsistence shall be paid for by the Contractor.
- J Equipment capacities, ratings, etc., are scheduled or specified for job site operating conditions. Equipment sensitive to altitude shall be derated with the method of derating identified on the submittals.
- K Enclosures for electrical equipment installed in mechanical equipment rooms shall be NEMA type 1 gasketed. Enclosures for electrical equipment installed outdoors shall be NEMA type 3R.
- L Energy consuming equipment shall be certified for use in the State of the project and shall meet the State Energy Code and local energy ordinances.

2.02 SUBSTITUTIONS

- A Contract Documents are based on equipment manufacturers as called out in the Specifications and indicated on the Drawings. Acceptance of substitute equipment manufacturers does not relieve Contractor of the responsibility to provide equipment and materials, which meet the performance as, stated or implied in the Contract Documents.
- B Submit proposals to provide substitute materials or equipment, in writing, with sufficient lead time for review prior to the date equipment must be ordered to maintain project schedule. Reimburse Owner for costs associated with the review of the proposed substitution whether substitution is accepted or rejected.
- C Indicate revisions required to adapt substitutions including revisions by other trades. Substitutions that increase the cost of the work and related trades are not permitted.
- D The proposed substitution shall conform to the size, ratings, and operating characteristics of the equipment or systems as specified and shown on the Drawings.
- E Proposals for substitutions shall include the following information:
 - 1. A description of the difference between the Contract Document requirements and that of the substitution, the comparative features of each, and the effect of the change on the end result performance. Include the impact of all changes on other contractors and acknowledge the inclusion of additional costs to the other trades.
 - 2. Schematic drawings and details.
 - 3. List of revisions to the Contract Documents that must be made if the substitution is accepted.
 - 4. Estimate of costs the Owner may incur in implementing the substitution, such as test, evaluation, operating and support costs.
 - 5. Statement of the time by which a Contract modification accepting the substitution must be issued, noting any effect on the Contract completion time or the delivery schedule.
 - 6. A statement indicating the reduction to the Contract price if the Owner accepts the substitution. Include required modifications to all related trades.

PART 3 EXECUTION

3.01 FEES AND PERMITS

- A Pay all required fees and obtain all required permits related to the electrical installation.
- B Pay royalties or fees in connection with the use of patented devices and systems.
- C Provide controlled inspection where required by authorities having jurisdiction or by these specifications.
- D Contractor is responsible for paying for all utility shutdown and/or startup fees associated with electrical installation within the contract scope of work.

3.02 SUBMITTALS AND REVIEWS

- A Submit shop drawings, manufacturer's product data sheets, samples, and test reports as specified.
- B Within two months after notice to proceed by the Owner or Owner's Representative, or after execution of Owner/Contractor Agreement, submit a complete typed list of all electrical equipment manufacturers and material suppliers for the equipment proposed to be provided on this project, as well as names of all subcontractors.
- C Within four months after notice to proceed by the Owner or Owner's Representative, or after execution of Owner/Contractor Agreement, prepare an index of all submittals for the project. Include a submittal identification number, a cross-reference to the Specification sections or Drawing number, and an item description. Prefix the submittal identification number by the Specification sections to which they apply. Indicate on each submittal, the submittal identification number in addition to the other data specified. All subcontractors shall utilize the assigned submittal identification number.
- D After the Contract is awarded, obtain complete shop drawings, product data and samples from the manufacturers, suppliers, vendors, and all subcontractors, for all materials and equipment as specified. Submit data and details of such materials and equipment for review. Prior to submission, certify that the shop drawings, product data and samples are in compliance with the Contract Documents. Check all materials and equipment upon their arrival on the job site and verify their compliance with the Contract Documents. Modify any work, which proceeds prior to receiving accepted shop drawings as required to comply with the Contract Documents and the shop drawings.
- E Review of submittals is for general compliance with the design concept and Contract Documents. Comments or absence of comments shall not relieve the Contractor from compliance with the Contract Documents. The Contractor remains solely responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of construction, for performing the work in a safe manner, and for coordinating the work with that of other trades.
- F No part of the work shall be started in the shop or in the field until the shop drawings and samples for that portion of the work have been submitted and accepted.
- G A minimum period of ten working days, exclusive of transmittal time, will be required in the Engineer's office each time a shop drawing, product data and/or samples are submitted for review. This time period must be considered by the Contractor in the scheduling of the work.
- H Submit electronic copies of all items requiring shop drawings. Submit electronic copies of manufacturer's product submittals. Electronic copies of submittals, with applicable markups, will be returned. Additional copies are the responsibility of the Contractor.
- I Submittals will be stamped as follows:

Stamp	Interpretation
No Exceptions Noted	Fabrication, manufacture, or construction may proceed providing submittal complies with the Contract Documents.
Exceptions Noted	Fabrication, manufacture, or construction may proceed

<input type="checkbox"/> Resubmit for Record <input type="checkbox"/> No Resubmission Required	providing submittal complies with the Contract Documents and the Engineer's notations.
Revise and Resubmit	Submittal does not comply with the Contract Documents. Do not proceed with fabrication, manufacture, or construction. The work and/or shop drawings are not permitted at the job site. Revise and resubmit submittal.
Reviewed for Information Only	Reyes Engineering, Inc. did not take part designing the system associated with this submittal. Reyes Engineering, Inc. has reviewed this submittal at the request of the project Architect and/or facility owner for information only. The submittal has not been reviewed for conformance with any contract document produced under the supervision of Reyes Engineering, Inc.. Any comments provided below are for general coordination or feedback purposes to the contractor or engineer of record.
Unreviewed	Submittal has not been reviewed.

- J Submit materials and equipment by manufacturer, trade name, and model number. Include copies of applicable brochure or catalog material. Maintenance and operating manuals are not acceptable substitutes for shop drawings.
- K Identify each sheet of printed submittal pages (using arrows, underlining or circling) to show applicable sizes, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable information. Note specified features such as materials or paint finishes.
- L Include dimensional data for roughing in and installation and technical data sufficient to verify that equipment meets the requirements of the Contract Documents. Include wiring, piping and service connection data.
- M Maintain a complete set of reviewed and stamped shop drawings and product data on site.
- N For each room or area of the building containing electrical equipment, submit the following:
 - 1. Floor Plans: Plan and elevation layout drawings indicating the equipment in the exact location in which it is intended to be installed. These plans shall be of a scale not less than $\frac{1}{4}$ inch = 1'-0". They shall be prepared in the following manner:
 - a. Indicate the physical boundaries of the space including door swings and ceiling heights and ceiling types (as applicable).
 - b. Illustrate all electrical equipment proposed to be contained therein. Include top and bottom elevations of all electrical equipment. The Drawings shall be prepared utilizing the dimensions contained in the individual equipment submittals. Indicate code and manufacturer's required clearances.
 - c. Illustrate all other equipment therein such as conduits, detectors, luminaries, ducts, registers, pull boxes, wireways, structural elements, etc.
 - d. Indicate the operating weight of each piece of equipment.
 - e. Indicate the heat release from each piece of electrical equipment in terms of BTU per hour. This information shall be that which is supplied by the respective manufacturers.
 - f. Illustrate concrete pads, curbs, etc.
 - g. Indicate dimensions to confirm compliance with code-required clearances.
 - h. Indicate maximum normal allowable operating temperature for each piece of equipment (as per each respective manufacturer's recommendation).

- i. Equipment removal routes.
- O The work described in shop drawing submissions shall be carefully checked by all trades for clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and coordination with other trades on the job. Each submitted shop drawing shall include a certification that related job conditions have been checked by the Contractor and each Subcontractor and that conflicts do not exist.
- P The Contractor is not relieved of the responsibility for dimensions or errors that may be contained on submissions, or for deviations from the requirements of the Contract Documents. The noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the shop drawings, product data and samples, the Contract Documents govern the work and are neither waived nor superseded in any way by the review of shop drawings, product data and samples.
- Q Inadequate or incomplete shop drawings, product data and/or samples will not be reviewed and will be returned to the Contractor for resubmittal.
- R Number all pages and drawings in product data brochures consecutively from beginning to end. Unless the following information is included, the submittal will be returned for resubmission. Resubmittals of product data or brochures shall include a cover letter summarizing the corrections made in response to the review comments.
 - 1. Indicate the following on the lower right hand corner of each shop drawing and on the coversheet of each product data brochure electronic submission:
 - a. The submittal identification number
 - b. Title of the sheet or brochure
 - c. Name and location of the project
 - d. Names of the Architect, Engineer, Contractor, Subcontractor, manufacturer, supplier, and vendor
 - e. The date of submittal; and the date of each correction, version and revision.
- S The distribution equipment, short circuit and coordination study, and room layout submittals shall be submitted concurrently. Failure to submit concurrently may result in the immediate return of the submittal marked REVISE AND RESUBMIT.

3.03 COORDINATION OF WORK

- A The Contract Documents establish scope, materials and quality but are not detailed installation instructions. Drawings are diagrammatic.
- B Coordinate work with related trades and furnish, in writing, any information necessary to permit the work of related trades to be installed satisfactorily and with the least possible conflict or delay.
- C The electrical drawings show the general arrangement of equipment and appurtenances. Follow these drawings as closely as the actual construction and the work of other trades will permit. Provide offsets, fittings, and accessories, which may be required but not shown on the Drawings. Investigate the site, and review drawings of other trades to determine conditions affecting the work, and provide such work and accessories as may be required to accommodate such conditions.
- D The locations of lighting fixtures, outlets, panels and other equipment indicated on the Drawings are approximately correct, but they are understood to be subject to such revision as may be found necessary or desirable at the time the work is installed in consequence of increase or reduction of the number of outlets, or in order to meet field conditions, or to coordinate with modular requirements of ceilings, or to simplify the work, or for other legitimate causes.

- E Exercise particular caution with reference to the location of panels, outlets, switches, etc., and have precise and definite locations accepted by the Architect before proceeding with the installation.
- F The Drawings show only the general run of raceways and approximate locations of outlets. Any significant changes in location of outlets, cabinets, etc., necessary in order to meet field conditions shall be brought to the immediate attention of the Architect for review before such alterations are made. Modifications shall be made at no additional cost to the Owner.
- G Verify with the Architect the exact location and mounting height of outlets and equipment not dimensionally located on the Drawings.
- H Circuit tags in the form of numbers are used where shown to indicate the circuit designation numbers in electrical panels. Show the actual circuit numbers on the as-built Record Drawings and on the associated typed panelboard directory card. Where circuiting is not indicated, provide required circuiting in accordance with the loading indicated on the Drawings and/or as directed.
- I The Drawings generally do not indicate the number of wires in conduit for the branch circuit wiring of fixtures and outlets, or the actual circuiting. Provide the correct wire size and quantity as required by the indicated circuiting and/or circuit numbers indicated, the control intent, referenced wiring diagrams (if any), the specified voltage drop or maximum distance limitations, and the applicable requirements of the NEC.
- J Carefully check space requirements with other trades to insure that equipment can be installed in the spaces allotted.
- K Wherever work interconnects with work of other trades, coordinate with other trades to insure that they have the information necessary so that they may properly install the necessary connections and equipment. Identify items (remote ballast, pull boxes, etc.) requiring access in order that the ceiling trade will know where to install access doors and panels.
- L Consult with other trades regarding equipment so that, wherever possible, motor controls and distribution equipment are of the same manufacturer.
- M Furnish and set sleeves for passage of electrical risers through structural masonry and concrete walls and floors and elsewhere as required for the proper protection of each electrical riser passing through building surfaces.
- N Provide firestopping around all pipes, conduits, ducts, sleeves, etc. which pass through rated walls, partitions and floors.
- O Provide detailed information on openings and holes required in precast members for electrical work.
- P Provide required supports and hangers for conduit and equipment, designed so as not to exceed allowable loadings of structures.
- Q Examine and compare the Contract Documents with the drawings and specifications of other trades, and report any discrepancies between them to the Architect and obtain written instructions for changes necessary in the work. Install and coordinate the work in cooperation with other related trades. Before installation, make proper provisions to avoid interferences.
- R Wherever the work is of sufficient complexity, prepare additional detail drawings to scale to coordinate the work with the work of other trades. Detailed work shall be clearly identified on the Drawings as to the area to which it applies. Submit these drawings to the Architect for review. At completion include a set of these drawings with each set of Record Drawings.
- S Furnish services of an experienced Superintendent, who shall be in constant charge of all work, and who shall coordinate work with the work of other trades. No work shall be installed before coordinating with other trades.

- T Coordinate with the local electric utility company and the local telephone company as to their requirements for service connections and provide all necessary metering provisions, grounding, materials, equipment, labor, testing, and appurtenances. Coordinate the electrical service installation with the Utility Company, contractor shall be responsible for all work related to the service that is not provided by the Utility. Coordinate with the owner's representative to arrange the existing building incoming service shutdown at least 4 weeks prior to commence,
- U Before commencing work, examine adjoining work on which this work is in any way affected and report conditions, which prevent performance of the work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.
- V Adjust location of conduits, panels, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each conduit prior to fabrication.
 - 1. Right-of-Way: Lines which pitch have the right-of-way over those which do not pitch. For example: condensate, steam, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
 - 2. Provide offsets, transitions and changes in direction of conduit as required to maintain proper headroom and pitch on sloping lines.
- W In cases of doubt as to the work intended, or in the event of need for explanation, request supplementary instructions from the Architect.

3.04 CONTRACTOR'S COORDINATION DRAWINGS

- A The Contractor shall coordinate efforts of all trades and shall furnish (in writing, with copies to the Architect) any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
- B The Contractor and all trade contractors shall prepare a complete set of construction Coordination Drawings indicating the equipment actually purchased and the exact routing for all lines such as busway, conduit, piping, ductwork, etc., including conduit embedded in concrete floors and walls. The Coordination Drawings shall be submitted complete to the Architect and the Engineer, within three months after notice to proceed is given, and in compliance with the construction schedule for the project. The sheet metal drawings, at a scale of not less than 1/4 inch to 1 foot, shall serve as the base drawings to which all other Contractors shall add their work. Each separate trade contractor shall draw their work on separate layers with different color assignments to facilitate coordination. Each Coordination Drawing shall be completed and signed off by the other Trade Contractors and the Contractor prior to the installation of the HVAC, plumbing, electrical and fire sprinkler work in the area covered by the specific drawing. The Contractor's work shall be installed according to the shop drawings and coordination drawings. If the Contractor allows one trade to install their work before coordination with the work of other trades, the Contractor shall make all necessary changes to correct the condition at no additional cost to the Owner.
- C The Contractors' Coordination Drawings shall indicate structural loads at support points for all piping 10 inch and larger, racked piping, racked conduit, busway, and suspended electrical equipment. Submit to Structural Engineer for review and approval. The elevation, location, support points, static, dynamic and expansion forces and loads imposed on the structure at support and anchor points shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. Work routed underground or embedded in concrete shall be indicated by dimension to column and building lines and shall be coordinated. Coordination Drawings shall document all required structural penetrations for initial

construction. Penetrations shall be dimensioned for walls, floors and roofs. These structural coordination requirements require review and approval by the Structural Engineer prior to completion and submittal of the drawings.

- D This requirement for Coordination Drawings shall not be construed as authorization for the Contractor or trade contractors to make any unauthorized changes to the Contract Documents. Contract document space allocations shall be maintained such as ceiling height, designated clearance for future construction and flexibility, chase walls, equipment room size, unless prior written authorization is received from the Architect to change them.
- E Prior to final acceptance of the Work the Contractor shall submit the Coordination Drawings as part of the Record Drawings submittal.

3.05 EXAMINATION OF SITE

- A Prior to the submitting of bids, visit the project site and become familiar with all conditions affecting the proposed installation and make provisions as to the cost thereof.
- B The Contract Documents do not make representations regarding the character or extent of the sub-soils, water levels, existing structural, mechanical and electrical installations, above or below ground, or other sub-surface conditions which may be encountered during the work. Evaluate existing conditions, which may affect methods or cost of performing the work, based on examination of the site or other information. Failure to examine the Drawings or other information does not relieve the Contractor of responsibility for the satisfactory completion of the work.

3.06 EXCAVATION AND BACKFILL

- A Provide excavation for the work of this Division. Excavate all material encountered, to the depths indicated on the Drawings or as required. Remove from the site excavated materials not required or suitable for backfill. Provide grading as may be necessary to prevent surface water from flowing into trenches or other excavations. Remove any water, which accumulates. Provide sheeting and shoring as may be necessary for the protection of the work and for the safety of personnel.
- B Provide trenches of widths necessary for the proper execution of the work. Grade bottom of the trenches accurately to provide uniform bearing and support the work on undisturbed soil at every point along its entire length. Except where rock is encountered, do not excavate below the depths indicated. Where rock excavations are required, excavate rock to a minimum overdepth of four inches below the trench depths indicated on the Drawings or required. Backfill overdepths in the rock excavation and unauthorized overdepths with loose, granular, moist earth, thoroughly machine tamped to a compaction level of at least 95% to standard proctor density or 75% relative density or as specified by the Architect. Whenever unstable soil that is incapable of properly supporting the work is encountered in the bottom of the trench, remove soil to a depth required and backfill the trench to the proper grade with coarse sand, fine gravel or other suitable material.
- C Excavate trenches for utilities that will provide the following minimum depths of cover from existing grade or from indicated finished grade, whichever is lower, unless otherwise specifically shown.
 - 1. Coordinate burial depths with civil engineer, serving utilities, and local codes.
 - 2. Electric service: 2 feet minimum.
 - 3. Telephone service: 2 feet minimum.
- D Trenches should not be placed within ten feet of foundation or soil surfaces, which must resist horizontal forces.
- E Do not backfill trenches until all required tests have been performed and installation observed by the Architect. Comply with the requirements of other sections of the Specifications. Backfill

shall consist of non-expensive soil with limited porosity. Deposit in 6 layers and thoroughly and carefully tamp until the work has a cover of not less than 1 foot. Backfill and tamp remainder of trench at 1 foot intervals until complete. Uniformly grade the finished surface.

3.07 CUTTING AND PATCHING

- A Where cutting, channeling, chasing or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support or anchorage of conduit or other equipment, layout the work carefully in advance. Repair any damage to the building, piping, equipment or defaced finished plaster, woodwork, metalwork, etc., using skilled tradespeople of the trades required at no additional cost to the Owner.
- B Do not cut, channel, chase or drill unfinished masonry, tile, etc., unless permission from the Architect is obtained. If permission is granted, perform this work in a manner acceptable to the Architect.
- C Where conduit or equipment are mounted on a painted finished surface, or a surface to be painted, paint to match the surface. Cold galvanize bare metal whenever support channels are cut.
- D Provide slots, chases, openings and recesses through floors, walls, ceilings, and roofs as required. Where these openings are not provided, provide cutting and patching to accommodate penetrations at no additional cost to the Owner.

3.08 MOUNTING HEIGHTS

- A Mounting heights shall conform to ADA requirements.
- B Verify exact locations and mounting heights with the Architect before installation.
- C Electrical and telecommunications outlets shall be mounted not lower than 15 inches above finished floor to bottom of outlet and not higher than 48 inches above finished floor to top of device.
- D Electrical switches shall be mounted not lower than 36 inches above finished floor to center of switch and not higher than 48 inches above finished floor to center of switch.
- E Fire alarm manual pull stations shall be mounted 48 inches above finished floor to center of manual pull station.
- F Outlets for public and other wall mounted type telephones shall be installed so that the particular telephone installed conforms to ADA mounting height requirements.
- G Visual Alarms: Mount not less than 80 inches to the bottom or 96 inches to the top of the device.
- H Wall Mounted Exit Signs: 2 inches above top of door to bottom of sign.
- I Low Level Exit Signs: 6 inches to bottom of sign.
- J Stairwell and utility corridor wall mounted lighting fixtures shall be mounted 8 feet 6 inches above finished floor or 1 foot below ceiling or structure above, whichever is lower.

3.09 CONTINUANCE OF EXISTING SERVICES

- A Existing electrical services not specifically indicated to be removed or altered shall remain as they presently exist.
- B Where existing services interfere with new construction, alter or reroute such existing equipment to facilitate new construction after obtaining written permission from the Architect. Notification in writing giving two weeks advance notice of planned alteration is required.
- C Preserve continuity of service of existing facilities (related to damage or alteration due to new construction). Unauthorized alteration to existing equipment shall be corrected without additional cost to the Owner.

3.10 DEMOLITION

- A Remove, relocate, and reroute existing electrical equipment to facilitate new construction or remodeling work.

- B Examine the site before submitting a bid to observe existing conditions.
- C Schedule demolition in advance. Schedule work to avoid disruption of normal operations.
- D Reconnect circuits serving equipment required to remain in service to other panelboards, motor control centers, or other appropriate distribution equipment. Provide additional panelboards, motor control centers, or other appropriate distribution equipment where there is insufficient available capacity in remaining existing equipment for reconnection.
- E Remove existing conduit and wire back to panelboard, motor control center, or other distribution source.
- F Where a circuit is interrupted by removal of a device or fixture from that circuit, provide additional conduit and wire to restore service to the remaining devices and fixtures on that circuit.
- G Electrical equipment to be removed that is in good working order shall be carefully removed and offered to the Owner. Items rejected by the Owner shall be removed from the project site and properly disposed of.

3.11 CLEANING UP

- A Avoid accumulation of debris, boxes, loose materials, crates, etc., resulting from the installation of this work. Remove from the premises each day all debris, boxes, etc., and keep the premises clean and free of dust and debris.
- B Clean all fixtures and equipment at the completion of the project. Wipe clean exposed lighting fixture reflectors and trim pieces with a non-abrasive cloth just prior to occupancy.
- C All electrical equipment shall be thoroughly vacuumed and wiped clean prior to energization and at the completion of the project. Equipment shall be opened for observation by the Architect as required.

3.12 WATERPROOFING

- A Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, make penetration prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
- B Restore waterproofing integrity of walls or surfaces after they have been penetrated without additional cost to the Owner.

3.13 SUPPORTS

- A Support work in accordance with the best industry practice. Provide supports, hangers, auxiliary structural members and supplemental hardware required for support of the work.
- B Provide supporting frames or racks extending from floor slab to ceiling slab for work indicated as being supported from walls where the walls are incapable of supporting the weight. In particular, provide such frames or racks in electric closets and mechanical equipment rooms.
- C Provide supporting frames or racks for equipment, which is installed in a freestanding position.
- D Supporting frames or racks shall be of standard angle, standard channel or specialty support system steel members, rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.
- E Adequate support of equipment (including outlet, pull and junction boxes and fittings) shall not depend on electric conduits, raceways, or cables for support.
- F Electrical equipment shall not rest on or depend for support on suspended ceiling media (tiles, lath, plaster, as well as splines, runners, bars and the like in the plane of the ceiling). Provide independent support of electrical equipment. Do not attach to supports provided for ductwork, piping or work of other trades.

- G Provide required supports and hangers for conduit, equipment, etc., so that loading will not exceed allowable loadings of structure. Electrical equipment and supports shall not come in contact with work of other trades.

3.14 FASTENINGS

- A Fasten equipment to building structure in accordance with the best industry practice.
- B Where weight applied to the attachment points is 100 pounds or less, conform to the following as a minimum:
 - 1. Wood: Wood screws.
 - 2. Concrete and solid masonry: Bolts and expansion shields.
 - 3. Hollow construction: Toggle bolts.
 - 4. Solid metal: Machine screws in tapped holes or with welded studs.
 - 5. Steel decking or sub-floor: Fastenings as specified below for applied weights in excess of 100 pounds.
- C Where weight applied to building attachment points exceeds 100 pounds, but is 300 pounds or less, conform to the following as a minimum:
 - 1. At concrete slabs provide 24 inch x 24 inch x ½ inch steel fishplates on top with through bolts. Fishplate assemblies shall be chased in and grouted flush with the top of slab screed line, where no fill is to be applied.
 - 2. At steel decking or sub-floor for all fastenings, provide through bolts or threaded rods. The tops of bolts or rods shall be set at least one inch below the top fill screed line and grouted in. Suitable washers shall be used under bolt heads or nuts. In cases where the decking or sub-floor manufacturer produces specialty hangers to work with their decking or sub-floor such hangers shall be provided.
- D Where weight applied to building attachment points exceeds 300 pounds, coordinate with and obtain the approval of Architect and conform to the following as a minimum:
 - 1. Provide suitable auxiliary channel or angle iron bridging between building structural steel elements to establish fastening points. Bridging members shall be suitably welded or clamped to building steel. Provide threaded rods or bolts to attach to bridging members.
- E For items, which are shown, as being ceiling mounted at locations where fastening to the building construction element above is not possible, provide suitable auxiliary channel or angle iron bridging tying to the building structural elements.
- F Wall mounted equipment may be directly secured to wall by means of steel bolts. Groups or arrays of equipment may be mounted on adequately sized steel angles, channels, or bars. Prefabricated steel channels as manufactured by Kindorf or Unistrut are acceptable.

3.15 IDENTIFICATION

- A Identify electrical equipment with permanently attached black phenolic nameplates with ½ inch high white engraved lettering. Identification shall include equipment name or load served as appropriate. Nameplates for equipment connected to the emergency power system shall be red with white lettering. Nameplates shall be attached with cadmium plated screws; peel and stick tape or glue on type nameplates are not allowed.
- B Cable tags shall be flameproof secured with flameproof non-metallic cord.
- C Provide an engraved nameplate for each switch controlling loads, which are not local to the switch.
- D Wherever raceways for future use are terminated outside of the building, stake the location with a 2 foot long, 1 inch x 1 inch clear heart redwood stake.
- E See individual sections for additional identification requirements.

3.16 PROHIBITED LABELS AND IDENTIFICATIONS

- A In all public areas, tenant areas, and similar locations within the project, the inclusion or installation of any equipment or assembly which bears on any exposed surface any name, trademark, or other insignia which is intended to identify the manufacturer, the vendor, or other source(s) from which such object has been obtained, is prohibited.
- B Required UL labels shall not be removed nor shall identification specifically required under the various technical sections of the Specifications be removed.

3.17 EQUIPMENT PADS AND ANCHOR BOLTS

- A Provide concrete pads under all floor mounted electrical equipment. Equipment pads shall conform to the shape of the piece of equipment it serves with a minimum 1 inch margin around the equipment and supports. Pads shall be a minimum of 4 inches high and made of a minimum 28 day, 2500psi concrete reinforced with 6 inch x 6 inch 6/6 gauge welded wire mesh. Trowel tops and sides of pad to smooth finishes, equal to those of the floors, with all external corners bullnosed to a $\frac{3}{4}$ inch radius. Shop drawings stamped NO EXCEPTIONS NOTED shall be used for dimensional guidance in sizing pads.
- B Provide galvanized anchor bolts for all equipment placed on concrete equipment pads, inertia blocks, or on concrete slabs. Provide bolts of the size and number recommended by the manufacturer of the equipment and locate by means of suitable templates. Equipment installed on vibration isolators shall be secured to the isolator. Secure the isolator to the floor, pad, or support as recommended by the vibration isolation manufacturer.
- C Where equipment is mounted on gypsum board partitions, the mounting screws shall pass through the gypsum board and securely attach to the partition studs. As an alternative, the mounting screws may pass through the gypsum board and be securely attached to 6 inches square, 18 gauge galvanized metal backplates, which are attached to the gypsum board with an approved non-flammable adhesive. Toggle bolts installed in gypsum board partitions are not allowed.

3.18 DELIVERY, DRAYAGE AND HAULING

- A Provide drayage, hauling, hoisting, shoring and placement in the building of equipment specified and be responsible for the timely delivery and installation of equipment as required by the construction schedule. If any item of equipment is received prior to the time that it is required, the Contractor shall be responsible for its proper storage and protection until the time it is required. Pay for all costs of drayage or storage.
- B If equipment is not delivered or installed at the project site in a timely manner as required by the project construction schedule, the Contractor shall be responsible for resulting disassembly, re-assembly, manufacturer's supervision, shoring, general construction modification, delays, overtime costs, etc. at no additional cost to the Owner.

3.19 EQUIPMENT AND MATERIAL PROTECTION

- A Protect the work, equipment, and material of other trades from damage by work or workmen of this trade, and correct damaged caused without additional cost to the Owner.
- B Take responsibility for work, materials, and equipment until finally inspected, tested and accepted. Protect work against theft, injury, or damage, and carefully store material and equipment received on site, which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material. Cover and protect equipment and materials from damage due to water, spray-on fireproofing, construction debris, etc. Store equipment to moisture damage in dry, heated spaces.
- C Provided adequate means for fully protecting finished parts of materials and equipment against damage from whatever cause during the progress of the work until final acceptance. Protect materials and equipment in storage and during construction in such a manner that no finished

surfaces will be damaged or marred, and moving parts are kept clean and dry. Do not install damaged items; take immediate steps to obtain replacement or repair.

- D Lighting fixture troffers with parabolic reflectors shall be installed with factory mounted plastic protective bags around parabolic reflector assembly. Remove protective bag just prior to occupancy.

3.20 TESTING OF ELECTRICAL SYSTEMS

- A Comply with the project construction schedule for the date of final performance and acceptance testing, and complete work sufficiently in advance of the Contract completion date to permit the execution of the testing prior to occupancy and Contract closeout. Complete any adjustments and/or alterations, which the final acceptance tests indicate as necessary for the proper functioning of all equipment prior to the completion date. See individual sections for extent of testing required.
- B Provide a detailed schedule of completion indicating when each system is to be completed and outlining when field testing will be performed. Submit completion schedule for review within six months after the notice to proceed by Owner's Representative has been given. Update this schedule periodically as the project progresses.

3.21 OPERATING INSTRUCTIONS

- A Provide the services of factory trained specialists to provide an operating instructions seminar for equipment and systems. The seminar shall be conducted over a five day (consecutive) period. Instruction time is defined as straight time working hours and does not include nights, weekends, or travel time to and from the project.
- B Submit seminar agenda, schedule and list of representatives to the Owner for approval thirty days prior to suggested date of seminar. Do not commence seminar until the Owner has issued a written acceptance of the starting time and attendees. Confirm attendance of seminar by written notification to participants.
- C Instruct Owner's operating personnel in proper starting sequences, operation, shutdown, general maintenance and preventative maintenance procedures, including normal and emergency procedures.
- D Submit final copies of Record Drawings and Operating and Maintenance Manuals to Owner at seminar.
- E Submit a written record of minutes and attendees of the seminar to the Owner.

3.22 OPERATING AND MAINTENANCE MANUALS

- A Provide Operating and Maintenance Manuals for equipment and materials furnished under this Division.
- B Maintenance manuals shall include complete cleaning and servicing data compiled in a clear and easily understandable format. Show model numbers of each piece of equipment, complete lists of replacement parts, capacity ratings, and actual loads.
- C Provide the following information where applicable:
 - 1. Identifying name and mark number.
 - 2. Locations (where several similar items are used, provide a list).
 - 3. Complete nameplate data.
 - 4. Certified Record Drawings and Final Reviewed submittals.
 - 5. Parts list.
 - 6. Performance curves and data.
 - 7. Wiring diagrams.
 - 8. Manufacturer's recommended operating and maintenance instructions with all non-applicable information deleted.
 - 9. List of spare parts recommended for normal service requirements.

10. Assembly and disassembly instructions with exploded view drawings where necessary.
 11. Test reports.
 12. Trouble shooting diagnostic instructions where applicable.
- D Submit electronic copies of operating and maintenance data books for review at least ten (10) weeks before the completion date. Assemble data in a completely indexed volume or volumes electronically as indicated for each item.

3.23 RECORD DRAWINGS

- A The Contractor shall maintain on a daily basis at the Project site a complete set of Record Drawings. The Record Drawings shall initially consist of a set of blueline prints or AutoCAD files of the Contractor's Coordination Drawings. The prints shall be marked or the AutoCAD files electronically updated to show the precise location of all buried or concealed work and equipment, including embedded conduit, raceways and boxes, and all changes and deviations in the Electrical work from that shown on the Contract Documents. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without definite written instructions from the Architect or Engineer. The updated Coordination Drawings shall be used to produce the final Record Drawings that shall be delivered to the Owner in AutoCAD electronic format media upon Project completion.
- B Record dimensions clearly and accurately to delineate the work as installed. Suitably identify locations of all equipment by at least two dimensions to permanent structures.
- C The Contractor and Subcontractor shall mark all in-progress Record Drawings on the front lower right hand corner with a rubber stamp impression or an AutoCAD image similar to the following:

RECORD DRAWING

(3/8 inch high letters)

To be used for recording Field Deviations and Dimensional Data Only

(5/16 inch high letters)

- D Upon completion of the work, the Contractor and subcontractors shall certify all Record Drawings on the front lower right hand corner adjacent to the above marking with a rubber stamp impression or an AutoCAD image similar to the following:

RECORD DRAWING

CERTIFIED CORRECT

(3/8 inch high letters)

(Printed Name of General Contractor)

(5/16 inch high letters)

Date:

(Printed Name of Subcontractor)

(5/16 inch high letters)

Date:

- E Prior to final acceptance of the Work of this Division, the Contractor shall submit properly certified Record Drawings to the Architect and Engineer for review and shall make changes, corrections, or additions as the Architect and/or Engineer may require to the Record Drawings. After the Architect's and Engineer's review, and any required Contractor revisions, the Record Drawings shall be delivered to the Owner on electronic media in AutoCAD format. The Architect and Engineer do not assume any responsibility for the accuracy or completeness of the Record Drawings.

3.24 FINAL PUNCHLIST

- A Prior to the Final Punchlist, certify that systems and equipment are complete, operational, and are in compliance with the Contract Documents.
- B During the Final Punchlist, provide personnel with access keys, hand held radios, and necessary expertise to operate each system and piece of equipment to demonstrate operational compliance with the Contract Documents.
- C Any deficiencies noted on the Final Punchlist shall be expeditiously corrected and certified in writing.
- D **early occupancy**
- E Complete those systems which are necessary to allow partial early occupancy of the building.
- F Verify and comply with requirements for temporary occupancy with the local Building and Fire Departments.

END OF SECTION 26 05 00

**SECTION 26 05 01
MINOR ELECTRICAL DEMOLITION**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Electrical demolition – minor alterations to existing electrical configurations at four schools.

PART 2 PRODUCTS**2.01 MATERIALS AND EQUIPMENT**

- A Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION**3.01 EXAMINATION**

- A Verify field measurements and circuiting arrangements are as shown on Drawings.
- B Verify that abandoned wiring and equipment serve only abandoned facilities.
- C Demolition drawings are based on casual field observation and existing record documents.
- D Report discrepancies to Resident Engineer before disturbing existing installation.
- E Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

- A Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B Coordinate communications interruptions and shutdowns with Resident Engineer.
 - 1. Obtain permission from Beaverton School District at least 24 hours before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.
- C Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D Existing Electrical power distribution: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Beaverton School District at least 24 hours before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.
- E Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Coordinate with Beaverton School District at least 48 hours before scheduling partially or completely disabling system.
 - 2. Notify local fire service.
 - 3. Make notifications at least 24 hours in advance.
 - 4. Make temporary connections to maintain service in areas adjacent to work area.
 - 5. Portions of the facility will require an operational fire alarm system during construction. Cross reporting of existing and new alarm system operation are expected to be required. full operational functionality of the cross reporting is required to meet fire code standards.
- F Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Notify Beaverton School District at least 24 hours before partially or completely disabling system.
 - 2. Notify telephone utility company at least 24 hours before partially or completely disabling system.

3. Make temporary connections to maintain service in areas adjacent to work area.
- G Existing Access Control/Intrusion System: Maintain existing system in service. Disable system only to make switchovers and connections. Minimize outage duration.
 1. Notify Beaverton School District at least 24 hours before partially or completely disabling system.
 2. Make temporary connections as required to maintain service in areas adjacent to work area.
 3. Where system is partially disabled, do not allow unauthorized personnel to enter.
- H Existing CCTV System: Maintain existing cameras in service as required until new systems are complete and ready for service. Maintain system Headend and any monitoring and recording devices in service until no longer required. Disable systems only to make switchovers and connections. Minimize outage duration.
 1. Notify Beaverton School District at least 24 hours before partially or completely disabling system.
 2. Make temporary connections to maintain service in areas adjacent to work area.
- I Existing Paging/Public Announcement System: Maintain existing system in service until new system is complete and ready for service. Maintain existing Headend in service until no longer required. Disable systems only to make switchovers and connections. Minimize outage duration.
 1. Notify Beaverton School District at least 24 hours before partially or completely disabling system.
 2. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A Remove, relocate, and extend existing installations to accommodate new construction.
- B Remove all abandoned communication cabling, power and lighting wiring to source of supply.
- C Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes and below raised floor. Cut conduit flush with walls and floors, and patch surfaces.
- D Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- E Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- F Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- G Disconnect, remove and store for later use all devices indicated on Drawings to be reused.
- H Repair adjacent construction and finishes damaged during demolition and extension work.
- I Maintain access to existing electrical installations and communications installations that remain active. Modify installation or provide access panel as appropriate.
- J Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

- A Clean and repair existing materials and equipment that remain or that are to be reused.
- B Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

END OF SECTION 26 05 01

SECTION 26 05 19**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES****PART 1 GENERAL****1.01 WORK INCLUDED**

- A Conductor sizes are sized for copper and shall be considered minimum for ampacities and voltage drop requirements.
- B Conductors for special systems shall be as recommended by the equipment manufacturer except as noted.
- C Deliver conductors to the job site in cartons, protective covers, or on reels.

1.02 SUBMITTALS

- A Product data.
- B Test reports.

PART 2 PRODUCTS**2.01 CONDUCTORS - 600V**

- A Type:
 - 1. Copper: No. 12 AWG minimum size unless noted otherwise, No. 8 and larger, Class B concentric or compressed stranded.
- B Insulation:
 - 1. Thermal setting, polyvinyl chloride: THW, THHN, THWN unless noted or specified otherwise.
 - 2. Cross linked polyethylene: XHHW-2
- C Thru wiring in luminaires shall be rated for 90-degree C minimum.
- D Manufacturers: Alcan, General, Essex, Rome, Southwire, or equal.
- E Color coding of conductors by system voltage is required:
 - 1. For 120/208 Volt power systems, utilize: Black, Red and blue for phase conductors. Utilize white for neutral conductors. Utilize green for ground conductors.
 - 2. For 277/480 Volt power systems, utilize: Brown, Orange and yellow for phase conductors. Utilize gray for neutral conductors. Utilize green with a yellow stripe for ground conductors.
- F Where a distinct color code system is currently in place, continue the current color code system.

2.02 POWER LIMITED WIRING

- A Copper, stranded or solid as recommended by the system manufacturer.
- B Insulation shall be appropriate for the system and location used.
- C Provide pre-manufactured, UL listed and labeled cable supports.

2.03 CONNECTORS - 600V AND BELOW

- A Branch Circuit Conductor Splices: Live spring type, Scotchlok, Ideal Wire Nut, Buchanan B-Cap, or 3M Series 560 self-stripping type.
- B Cable Splices: Compression tool applied sleeves, Kearney, Burndy, or equal with 600V heat shrink insulation. For cable splices in sub-terrain/underground vaults or any wet locations shall be provided with 600V 3M Series DBR-6 or approved.
- C Terminator Lugs for Stranded Wire:
 - 1. No. 10 Wire and Smaller: Spade flared, tool applied.
 - 2. No. 8 Wire and Larger: Compression tool applied, Burndy, Anderson, or equal. Set screw type terminator lugs supplied as an integral part of switches and circuit breakers will be acceptable for terminating only copper conductors.

PART 3 EXECUTION

3.01 CONDUCTORS

- A Pulling compounds may be used for pulling all power system conductors. Clean residue from the conductors and raceway entrances after the pull is made.
- B Pulleys or blocks shall be used for alignment of the conductors when pulling. Pulling shall be in accordance with manufacturer's specifications regarding pulling tensions, bending radii of the cable, and compounds. A dynamometer shall be utilized on all high voltage cable pulls to ensure that the maximum allowed cable tension is not exceeded. The Architect and Engineer shall be notified prior to all cable pulls. Record the maximum strain of each pull.
- C Conductors entering terminal or junction boxes mounted on hermetically sealed refrigeration compressor motors shall be copper.
- D Make up and insulate wiring promptly after installation of conductors. Wire shall not be pulled in until all bushings are installed and raceways terminations are completed. Wire shall not be pulled into conduit embedded in concrete until after the concrete is poured and forms are stripped.
 - 1. Wire devices external to isolating panels with copper stranded conductors having a cross-linked polyethylene insulation or equivalent with a dielectric constant of 3.5 or less.
- E Minimum insulation wall thickness shall be 1/32" for #10 and #12 AWG and 5/64" for #8 AWG and larger conductors. Wiring shall be color coded in accordance with NEC and appropriate NFPA standards.

3.02 CONNECTORS

- A Control and special systems wires shall be terminated with a tool applied spade flared lug when terminating at a screw connection.
- B All tool applied compression connectors shall be applied per manufacturer's recommendations and physically checked for tightness.

3.03 COLOR CODING

- A Secondary service, feeders, and branch circuit conductors shall be color coded. Phase color code to be consistent at all feeder terminations, A-B-C left-to-right, A-B-C top-to-bottom, or A-B-C front-to-back.
- B Use solid color compound or solid color coating for No. 12 and No. 10 branch circuit conductors and neutral sizes.
- C Phase conductors No. 8 and larger color code using one of the following:
 - 1. Solid color compound or solid color coating.
 - 2. Stripes, bands, or hash marks of color specified above.
 - 3. Colored as specified using 3/4-inch wide tape. Apply tape in half overlapping turns for a minimum of three inches for terminal points and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
- D Switchlegs, travelers, etc., to be consistent with the phases to which connected or a color distinctive from that listed.
- E Color coding of the flexible wiring system conductors and connectors shall be the manufacturer's standard.
- F For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.

3.04 TESTS:

- A Perform insulation resistance tests on all new phase and neutral conductors of feeders and circuits over 100 Amperes ampacity, 480 Volt and below, with a 1000 Volt, direct current,

megohmmeter. The written test report listing the results of the test to be submitted to Architect. Equipment which may be damaged by this test shall be disconnected prior to the test.

1. The energizing feeder end enclosure and the panel feeder end enclosure must be opened and visually reviewed.
2. The feeder energizing circuit breaker will be opened.
3. The panel branch circuit breakers will be opened. This should isolate the feeder conductors from the building electrical power system.
4. The isolation of the feeder conductors will be confirmed with a low power, hand held Ohmmeter. This test is required to confirm the absence of any load (due to a malfunctioning circuit breaker being stuck in the "closed" position) on the feeder. This basically assures the feeder can be expected to safely be energized via the megohmmeter.
5. Testing of the feeder insulation can be performed from either the energizing feeder end or from the panel end at the Contractors discretion based on test energized conductor, inadvertent access, safety.
6. The resistance test between the feeder neutral conductor and the feeder conduit is intended to measure the continuity of the feeder conduit. This measurement must be taken from the panel interior. Measured resistance accuracy of +/- 0.1 ohm is accepted.

END OF SECTION 26 0519

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL**1.01 WORK INCLUDED**

- A Include bonding of conduit systems.
- B Maintain electrical continuity of the existing ground array system as specified herein and shown on the Drawings. Included in this section are the minimum composition requirements and installation methods for the following:
 - 1. Busbars
 - 2. Bonding accessories

1.02 QUALITY ASSURANCE

- A All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufactures listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- B Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- C Material and work specified herein shall comply with the applicable requirements of the following standards and the Authority Having Jurisdiction (AHJ).
 - 1. ANSI/TIA/EIA – 568 Commercial Building Telecommunications Cabling Standard
 - 2. TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces
 - 3. ANSI/TIA/EIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 - 4. ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
 - 5. NFPA 70 – National Electric Code
 - 6. BICSI – Telecommunications Distribution Methods Manual, 14th Edition,

PART 2 PRODUCTS**2.01 GROUNDING CONDUCTORS**

- A Green, 600 Volt, polyvinyl Chloride, THWN insulated copper for interior systems.
- B Bare copper for underground or exterior systems.

2.02 CONNECTORS

- A Cast, Compression, set screw or bolted type for building internal conductor termination.
- B Form poured, exothermic welds (Cadweld) for use: exterior to the building, where exposed to the elements or below grade or underground.
- C Grounding lugs where provided as standard manufacturer's items on equipment.

2.03 GROUND PADS

- A Provide a ground pad at each location shown on the Drawings. The default Pad shall be 1000A rated copper bus nominally 1/4"x3"x12" long.
- B Mount ground pads with stand-off devices to provide a minimum of 1-1/2 inches free space behind pad for access to lug nuts and washers.

2.04 GROUND RODS

- A Copper clad steel, 5/8"x10'-0" long ground rods. Where ground wells are indicated, provide a 12-inch deep, 8-inch diameter precast concrete well with flush lid for accessibility and inspection of welded connections.

- B Utilize RCP Vaults No. 12R12A with 12R12-t cover.

2.05 WALL-MOUNT BUSBARS

A Telecommunications Main Grounding Busbar (TMGB)

1. Telecommunications Main Grounding Busbar (TMGB) shall be constructed of .25" (6.4 mm) thick solid copper bar.
2. The busbar shall be 4"H x 20"L (100 mm x 510 mm) and shall have 30 attachment points (two rows of 15 each) for two-hole grounding lugs.
3. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI-J-STD – 607-A and shall accept 27 lugs with 5/8" (15.8 mm) hole centers and 3 lugs with 1" (25.4 mm) hole centers.
4. The busbar shall include wall-mount stand-off brackets, assembly screws and insulators creating a 2.5" (63.5 mm) standoff from the wall.
5. The busbar shall be UL Listed as grounding and bonding equipment.
6. The wall-mounted TMGB busbars are bonded to the building reference ground electrode system. The connection to the building reference ground electrode system is part of the overall Telecommunications Bonding and Grounding System.

B Telecommunications Grounding Busbar (TGB)

1. Telecommunications Grounding Busbar (TGB) shall be constructed of .25" (6.4 mm) thick solid copper bar.
2. The busbar shall be 2"H x 12"L (50 mm x 300 mm) and shall have 9 attachment points (one row) for two-hole grounding lugs.
3. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI-J-STD – 607 and shall accept 6 lugs with 5/8" (15.8 mm) hole centers and 3 lugs with 1" (25.4 mm) hole centers.
4. The busbar shall include wall-mount stand-off brackets, assembly screws and insulators creating a 2.5" (63.5 mm) standoff from the wall.
5. The busbar shall be UL Listed as grounding and bonding equipment.
6. The wall-mounted TGB busbars are bonded to the building reference ground electrode system. The connection to the building reference ground electrode system is part of the overall Telecommunications Bonding and Grounding System.

C Two Mounting Hole Ground Terminal Block

1. Ground terminal block shall be made of electroplated tin aluminum extrusion.
2. Ground terminal block shall accept conductors ranging from #14 AWG through 2/0.
3. The conductors shall be held in place by two stainless steel set screws.
4. Ground terminal block shall have two 1/4" (6.4 mm) holes spaced on 5/8" (15.8 mm) centers to allow secure two-bolt attachment to the rack or cabinet.
5. Ground terminal block shall be UL Listed as a wire connector.

D Compression Lugs

1. Compression lugs shall be manufactured from electroplated tinned copper.
2. Compression lugs shall have two holes spaced on 5/8" (15.8 mm) or 1" (25.4 mm) centers, as stated below, to allow secure two bolt connections to busbars.
3. Compression lugs shall be sized to fit a specific size conductor, sizes #6 to 4/0, as stated below.
4. Compression lugs shall be UL Listed as wire connectors.

PART 3 EXECUTION

3.01 INSTALLATION

- A Grounding Conductors: Default sized in accord with Article 250, Tables 250-122 and 250-66 of the National Electrical Code. Where larger size conductors are indicated on the drawings, utilize the size indicated on the drawings.
- B Grounding Conductor Connectors: Made up tight and located for future servicing and to insure low impedance.
- C Ground the electrical system, the cold-water service, structural steel, and transformers to the building ground grid.
- D All Plug-in Receptacles: Bonded to the boxes, raceways, and grounding conductor.
- E Provide equipment grounding conductor in all PVC conduit runs.
- F Provide ground bonding to above ground portion of metal gas piping per NEC 250-104(b).
- G All separately derived systems shall be solidly grounded to the reference ground electrode system via the building reference ground access conductor system.

3.02 EQUIPMENT

- A Provide separate green insulated equipment ground conductor in all non-metallic and flexible electrical raceways. Effectively ground all luminaires, panels, controls, motors, disconnect switches, exterior lighting standards, and noncurrent carrying metallic enclosures. Use bonding jumpers, grounding bushings, lugs, buses, etc., for this purpose.
- B Provide grounding bushings on all feeder conduit entrances to panels and equipment enclosures and bond bushings to enclosures with minimum No. 10 AWG conductor. Connect the equipment ground to the building system ground. Use the same size equipment ground conductors as phase conductors, up through No. 10 AWG.

3.03 GROUND PADS

- A Drill ground pads as necessary for attachment of all grounding conductors as required.
- B Utilize 2-hole lugs for terminating No. 4/0 AWG and larger ground conductors.
- C Bond ground pads to adjacent existing accessible structural steel with #4/0 bare copper cable, using form poured exothermic welds.

3.04 GROUND RESISTANCE TEST

- A Ground electrode resistance test shall be accomplished with a ground resistance direct-reading single test meter utilizing the Fall-of-Potential method and two reference electrodes. Perform test prior to interconnection to other grounding systems. Orient the concrete-encased ground electrode to be tested and the two reference electrodes in a straight line spaced fifty (50) feet apart. Drive the two reference electrodes five (5) feet deep.
- B Test results shall be in writing and shall show temperature, humidity and condition of the soil at the time of the tests in the case where the ground resistance exceeds 5 ohms. The Engineer will issue additional instructions.

3.05 WALL-MOUNT BUSBARS

- A Attach busbars to the wall with appropriate hardware according to the manufacturer's installation instructions.
- B Conductor connections to the power, TMGB or TGB shall be made with two-hole bolt-on compression lugs sized to fit the busbar and the conductors.
- C Each lug shall be attached with stainless steel hardware after preparing the bond according to manufacturer recommendations and treating the bonding surface on the busbar with antioxidant to help prevent corrosion at the bond.
- D The wall-mounted busbars are bonded to the building reference ground electrode system. The connection to the building reference ground electrode system is part of the overall Telecommunications Bonding and Grounding System.

END OF SECTION 26 05 26

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

- A Section 01 60 00, Product Requirements
- B Section 03 30 00, Cast-in-Place Concrete
- C Section 05 50 00, Metal Fabrications
- D Section 26 05 33, Raceway and Boxes for Electrical Systems
- E Section 26 51 00, Interior Lighting
- F Section 26 56 00, Exterior Lighting

1.03 REFERENCE STANDARDS

- A ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013.
- B ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2013.
- D MFMA-4 - Metal Framing Standards Publication; Metal Framing Manufacturers Association; 2004.
- E NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- F NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00, Cast-in-Place Concrete.

1.05 SUBMITTALS

- A See Division 01 - Administrative Requirements, for submittal procedures.
- B Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.

1.06 QUALITY ASSURANCE

- A Comply with NFPA 70.
- B Comply with applicable building code.

PART 2 PRODUCTS**2.01 SUPPORT AND ATTACHMENT COMPONENTS**

- A General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 - 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 - 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 150%. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 - 5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B Materials for Metal Fabricated Supports: Comply with Section 05 50 00, Metal Fabrications.
- C Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
 - 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 - 2. Conduit Clamps: Bolted type unless otherwise indicated.
 - 3. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com.
 - b. Erico International Corporation: www.erico.com.
 - c. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
 - d. Thomas & Betts Corporation: www.tnb.com.
 - e. Substitutions: See Section 01 60 00, Product Requirements.
- D Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
 - 1. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com.
 - b. Erico International Corporation: www.erico.com.
 - c. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
 - d. Thomas & Betts Corporation: www.tnb.com.
 - e. Substitutions: See Section 01 60 00, Product Requirements.
- E Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 - 1. Comply with MFMA-4.
 - 2. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 - 3. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.

- b. Thomas & Betts Corporation: www.tnb.com.
 - c. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
- F Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
- 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Busway Supports: 1/2 inch diameter.
 - c. Single Conduit up to 1 inch (27mm) trade size: 1/4 inch diameter.
 - d. Single Conduit larger than 1 inch (27mm) trade size: 3/8 inch diameter.
 - e. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
 - f. Outlet Boxes: 1/4 inch diameter.
 - g. Luminaires: 1/4 inch diameter.
- G Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber 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.
- 1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 - 3. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
 - 4. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.
 - b. Erico International Corporation: www.erico.com.
 - c. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
 - d. Substitutions: See Section 01 60 00, Product Requirements.
- H Anchors and Fasteners:
- 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 - 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 - 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 - 4. Hollow Masonry: Use toggle bolts.
 - 5. Hollow Stud Walls: Use toggle bolts.
 - 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 - 7. Sheet Metal: Use sheet metal screws.
 - 8. Wood: Use wood screws.
 - 9. Plastic and lead anchors are not permitted.
 - 10. Powder-actuated fasteners are not permitted.
 - 11. Hammer-driven anchors and fasteners are not permitted.
 - 12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch minimum base metal thickness.
 - d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
14. Manufacturers - Mechanical Anchors:
 - a. Hilti, Inc: www.us.hilti.com.
 - b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com.
 - c. Powers Fasteners, Inc: www.powers.com.
 - d. Substitutions: See Section 01 60 00, Product Requirements

PART 3 EXECUTION

3.01 EXAMINATION

- A Verify that field measurements are as shown on the drawings.
- B Verify that mounting surfaces are ready to receive support and attachment components.
- C Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A Install products in accordance with manufacturer's instructions.
- B Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.
- C Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- F Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- G Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- H Equipment Support and Attachment:
 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I Conduit Support and Attachment: Also comply with Section 26 05 33, Raceway and Boxes for Electrical Systems.
- J Box Support and Attachment: Also comply with Section 26 05 33, Raceway and Boxes for Electrical Systems.
- K Interior Luminaire Support and Attachment: Also comply with Section 26 51 00, Interior Lighting.
- L Exterior Luminaire Support and Attachment: Also comply with Section 26 56 00, Exterior Lighting.
- M Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- N Secure fasteners according to manufacturer's recommended torque settings.
- O Remove temporary supports.

- P Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

- A See Section 01 40 00, Quality Requirements, for additional requirements.
- B Inspect support and attachment components for damage and defects.
- C Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 05 29

SECTION 26 05 33**RACEWAY, BOXES, AND CONDUITS FOR ELECTRICAL SYSTEMS****PART 1 GENERAL****1.01 WORK INCLUDED**

- A Provide raceways and conduits of specified types for all electrical systems wiring, except where clearly shown or specified otherwise. All fittings, boxes, hangers and appurtenances shall be included.
- B Size raceways and conduits as specified. Where no size is indicated, conduit may be the minimum code permitted size for the quantity of conductors installed, based upon NEC tables for conductors with type THW/TW insulation.

PART 2 PRODUCTS**2.01 METALLIC CONDUITS**

- A Galvanized Rigid Conduit (GRC): Smooth surfaced heavy wall mild steel tube of uniform thickness and temper, reamed and threaded at each end and protected inside and out with galvanizing, sherardizing, or equivalent process. GRC shall comply with NEC Article 346.
- B Intermediate Metallic Conduit (IMC): Smooth surface, intermediate wall mild steel tube of uniform thickness and temper, reamed and threaded at each end, and protected inside and out with galvanizing, sherardizing, or equivalent process. IMC shall comply with NEC Article 345.
- C Electrical Metallic Tubing (EMT): Smooth surface, thin wall mild steel tube of uniform thickness and temper, galvanized or sherardized on the outside, and enameled on the interior. EMT shall comply with NEC Article 348.
- D Flexible Conduits (Flex):
 - 1. Flexible Metallic Conduit: Interlocking single strip steel construction, galvanized inside and out after fabrication. Flex shall comply with NEC Article 350.
 - 2. Liquid Tight: Similar to flexible metallic conduit, except encased in a liquid tight polyvinylchloride or equivalent outer jacket over the flexible steel core, and shall comply with NEC Article 351.

2.02 NON-METALLIC CONDUITS

- A Underground Ducts:
- B PVC, Encased Burial: Type EB for concrete encasement, shall meet or exceed the current requirements of EB-20/ASTM F512, NEMA TC-6 and U.L. 651. Rate for use with 90°C wire.
- C PVC, Direct Burial: Type DB suitable for direct burial, shall meet or exceed the current requirements of DB-20/ASTM F512 and NEMA TC-6. Rate for use with 90°C wire.
- D Rigid Non-Metallic Conduit: Type II PVC Schedule 40, suitable for use with 90°C rated wire. Conduit shall conform to UL Standard 651 and carry appropriate UL listing for above and below ground use.

2.03 WIREWAYS

- A Troughs: Steel, painted, square in cross section, preformed knock-outs on standard spacing, screw cover.
- B Fittings: Tees, elbows, couplings as required for configuration shown on the Drawings.

2.04 FITTINGS

- A GRC and IMC:
 - 1. Threaded Locknuts: Sealing type where used with NEMA 2, 3, 3R, 4 and 12 enclosures.
 - 2. Threaded Bushings: 1 1/4 inch and larger, insulated, grounding type as required under Section 26 05 26, Grounding and Bonding for Electrical Systems.

3. Threaded Couplings: Standard threaded of the same material and as furnished with conduit supplied. Erickson type couplings may be used where required to complete conduit runs larger than 1 inch.
- B EMT:
 1. Connectors: Steel compression ring or steel set screw type for conduit termination, with insulated throat, suitable for conditions used.
 2. Steel EMT fittings are required to have at least 5% recycled steel content.
 3. Use lay-in grounding type bushings where terminating grounding conductors.
 4. Couplings: Steel compression ring or steel set screw type, concrete tight.
- C Threadless: GRC and IMC couplings and box connectors may be steel threadless, compression ring or set screw type for use with conduits 1 inch and smaller where installed in poured concrete locations or where limited working space makes threaded fittings impractical.
- D Weatherproof Connectors: Threaded.
- E Expansion Couplings: Equal to O.Z. type EX with jumper.
- F Seal-Offs: With filler fiber, compound, removable cover.

2.05 METALLIC BOXES

- A Flush and Concealed Outlet Boxes: For interior installation, provide:
 1. Electroplate Zinc galvanized stamped steel
 2. All interior installation backboxes are 4 inch square minimum, with 1-1/2 inch minimum depth
 3. Depth of backbox is required to be adjusted as required to meet current National Electrical code fill requirements
 4. Provide backboxes with screw ears for device ring mounting, knock-out plugs, mounting holes, and fixture studs if required
 5. Provide backboxes with green bolt, threaded ground conductor termination capability
 6. Terminate copper raceway bonding conductor at backbox threaded ground termination via green threaded bolt
 7. Terminate copper raceway bonding conductor on circuit ground conductor via conductor splice
 8. Isolated circuit ground conductors are not bonded to the backbox threaded ground termination
 9. RACO or equal
- B Surface Outlet Boxes: Galvanized stamped steel same as above for use on ceilings; cast steel or aluminum with threaded hubs or bosses for use on walls.
- C Large Boxes: Boxes exceeding 4-11/16 inches square when required shall be welded steel construction with screw cover and painted, steel gauge as required by physical size, Hoffman, Circle AW or equal.
- D Systems: Boxes for systems devices shall be as recommended by the systems manufacturer, suitable for the equipment installed. Equip with grounding lugs, brackets, device rings, etc., as required.

PART 3 EXECUTION

3.01 INSTALLATION

- A Mount backboxes staggered in wall framing spaces to reduce acoustic coupling from one space to another. Back to back backbox installation is not allowed.
- B Conceal all conduits in finished spaces. Concealed conduits shall run in a direct line with long sweep bends and offsets. GRC and IMC embedded in concrete below grade or in damp

locations shall be made watertight by painting the entire male thread with Rustoleum metal primer or equal before assembly.

- C Route exposed conduit parallel or at right angles to structural building lines and neatly offset into boxes. Conduits attached directly to building surfaces shall closely follow the surfaces. Conduit fittings shall be used to "saddle" under beams. Drilling or notching of existing beams, trusses on structural members shall be coordinated with Architect prior to commencing.
- D GRC and IMC terminations at boxes, cabinets, and general wiring enclosures shall be rigidly secured with double locknuts and bushings or approved fittings. Conduit shall be screwed in and shall engage at least five threads in hub where conduit boxes with threaded hubs or bosses are used. Insulating bushings shall be used for conduits 1-1/4 inches or larger.
- E Keep conduit and raceways closed with suitable plugs or caps during construction to prevent entrance of dirt, moisture, concrete, or foreign objects. Raceways shall be clean and dry before installation of wire and at the time of acceptance.
- F Pack spaces around conduits with polyethylene backing rods and seal with polyurethane caulking to prevent entrance of moisture where conduits are installed in sleeves or block-outs penetrating moisture barriers.

3.02 CONDUIT

- A Minimum raceway size for power circuits is 3/4 inch, industry standard measure.
- B Minimum raceway size for low energy control circuits is 1/2 inch, industry standard measure.
- C Control circuits are to be routed via dedicated raceways, separate from power conductors. Control circuits with the same disconnecting means as the power circuit, and NEC compliant insulation matching the power circuit insulation rating may be routed in a common raceway with the power conductors.
- D Raceways crossing structure expansion joints or structure seismic joints shall have adequate range (axial as well as transverse) of intrinsic motion compensation to meet the structure design motion limits.
- E Provide NEC sized, bonded internal grounding continuity conductors within raceways crossing structure expansion joints or structure seismic joints as required to assure raceway ground continuity during and after the structure design motion limits.
- F Structure design motion limits include shortening as well as lengthening of the instantaneous raceway length as compared to the circuit length. Conductors or cables installed in raceways crossing structure expansion joints or structure seismic joints shall have adequate coiled circuit length and coil storage space to meet the structure design motion limits. The conductors are expected to slide within the raceway system as required to maintain circuit continuity and insulation integrity during the structure design motion limits.
- G Conduits for branch circuit use are required to have not more than 40% fill at the completion of the project.
- H GRC may be used in all areas for wiring systems. GRC shall be installed for wiring underground in cast concrete construction, in damp locations, and in hazardous areas for serving fire pump controllers and where subject to mechanical injury with threaded fittings made up tight. IMC may be used in locations not in contact with earth or fill.
- I EMT may be used in all other dry protected locations. Provide green equipment bonding conductor where used for power circuit feeders 2-inch and larger. EMT, whether exposed or concealed, shall be securely supported and fastened at intervals of nominally every 8 feet and within 24 inches of each outlet, ell, fitting, panel, etc.
- J Flex shall be used for connections to vibration producing equipment and where installation flexibility is required with a minimum 12 inches slack connection. Limit flex length to 36 inches

- for exposed equipment connections and 72 inches in concealed ceiling and wall cavities. PVC jacketed flex shall be used in wet locations, areas subject to wash-down, and exterior locations.
- K PVC Type II Schedule 40 may be used underground and in and under interior slabs, poured concrete walls, and where scheduled or noted on the Drawings. Make connections with waterproof solvent cement. Provide GRC at 60 degree and larger bends and where penetrating slabs.
 - L MC Cable may be used as permitted per NEC, state and local codes. MC Cable not permitted for feeders, service entrance feeders and homeruns.

3.03 RACEWAYS

- A Surface metal wireways may be installed at locations to serve motor starters or other control devices where required by a multitude of wiring interconnections or physical layout.

3.04 FITTINGS

- A Metallic raceways and conduits shall be assembled continuous and secured to boxes, panels, etc., with appropriate fittings to maintain electrical continuity. All conduit joints shall be cut square and reamed smooth with all fittings drawn up tight.
- B Crimp-on, tap-on, indenter type, malleable iron or cast set screw fittings shall not be used.

3.05 BOXES

- A Boxes and outlets shall be mounted at nominal center line heights shown on the drawings. Adjust heights in concrete masonry unit (CMU) walls to prevent devices or finish plates from spanning masonry joints.
- B Boxes are to be located and accessible for service, inspection or circuiting adjustment at the time of final project completion. Access clearance is required to meet current NEC, NESC, OSHA and NFPA 70E requirements.
- C Permanently label all boxes per specification requirements. At a minimum, the panel of energization and circuit breaker number shall be visible.
- D Circuiting exiting panel or switchboard enclosures shall have metal conduit protection.
- E Outlet boxes shall be of code required size to accommodate all wires, fittings, and devices. Provide multi-gang boxes as required to accept devices installed with no more than one device per gang. Equip all metallic boxes with grounding provisions.
- F Flush wall switch and receptacle outlets used with conduit systems shall be 4 inches square, 1-1/2 inches or deeper, with one or two-gang plaster ring mounted vertically. Where three or more devices are at one location, use one-piece multiple gang tile box or gang box with suitable device ring.
- G Wall bracket and ceiling surface mounted luminaire outlets shall be 4-inch octagon 1-1/2 inches deep with 3/8-inch fixture stud where required. Wall bracket outlets to have single gang opening where required to accommodate fixture canopy. Provide larger boxes or extension rings where quantity of wires installed requires more cubic capacity.
- H Junction boxes installed in accessible ceiling or wall cavities or exposed in utility areas shall be a minimum of 4 inches square, 1-1/2 inches deep with appropriately marked blank cover.
- I Boxes for the special systems shall be suitable for the equipment installed. Coordinate size and type with the system supplier.
- J Provide pull boxes where shown for installation of cable supports or where required to limit the number of bends in any conduit to not more than three 90-degree bends. Use galvanized boxes of code required size with removable covers installed so that covers will be accessible after work is completed.

- K Recessed boxes shall be flush with finished surfaces or not more than 1/8-inch back. Set boxes level and plumb. Long screws with spacers or shims for mounting devices will not be acceptable. No combustible material shall be exposed to wiring at outlets.
- L Covers for flush mounted boxes in finished spaces shall extend a minimum of 1/4-inch beyond the box edge to provide a finished appearance. Finish edge of cover to match cover face.
- M Boxes installed attached to a stud in sheet rock walls shall be equipped with opposite side box supports equal to Caddy #760. Install drywall screw prior to finish taping. Methods used to attach boxes to studs shall not cause projections on the face of the stud to prevent full length contact of sheet rock to the stud face.

3.06 PULL WIRES

- A Install nylon pull lines in all empty conduits larger than 1 inch where routing includes 25 feet or more in length or includes 180 degrees or more in bends.
- B Where conduits requiring pull lines are stubbed out and capped, coil a minimum of 36 inches of pull line and tape at termination of conduit for easy future access. Label pull lines as to conduit starting or terminations point and intended future use.

END OF SECTION 26 05 33

**SECTION 26 05 75
ELECTRICAL TESTING**

PART 1 GENERAL**1.01 WORK INCLUDED**

- A Perform field tests and operational checks to assure that all electrical equipment, both contractor and Owner supplied, is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications.
- B The tests and operational check shall determine the suitability for energization.
- C Schedule tests and give a minimum of one week's advance notice of time and date to the Architect and Owner for any major systems tests specified in this Section.

1.02 INDEPENDENT TESTING AGENCY

- A Where indicated in Part 3 of these Specifications, the test and/or operational check shall be performed by a recognized independent testing agency engaged and paid for by the Contractor.
- B The testing agency shall meet Federal OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907. Membership in the National Electrical Testing Association constitutes proof of meeting such criteria.
- C The testing agency shall be responsible for implementing final settings and adjustments on equipment and protective devices in accordance with the Engineers specified values or as recommended by the device or systems manufacturer after system testing.

1.03 SUBMITTALS

- A Test Reports: Submit three copies of the completed report to the Architect no later than fifteen (15) days after completion of test unless directed otherwise. The test reports shall be bound and its contents certified.
- B The test report shall include the following:
 - 1. Summary of project.
 - 2. Description of equipment tested.
 - 3. Description of test.
 - 4. List of test equipment used in calibration and calibration date.
 - 5. Test results.
 - 6. Conclusions and recommendations.
 - 7. Appendix, including copies of appropriate test forms used in the field.

PART 2 PRODUCTS**2.01 TESTING EQUIPMENT**

- A The testing agency shall have a calibration program which maintains all applicable test instrumentation within rated accuracy. The accuracy shall be traceable to the National Bureau of Standards in an unbroken chain. Instruments shall be calibrated in accordance with the following frequency schedule:
 - 1. Field Instruments: 6 months maximum.
 - 2. Laboratory Instruments: 12 months.
 - 3. Leased Specialty Equipment: 12 months (where accuracy is guaranteed by lessor).Dated calibration labels shall be visible on all test equipment.

PART 3 EXECUTION**3.01 SHORT-CIRCUIT STUDY**

- A Provide a current and complete short-circuit study and equipment withstand evaluation for the electrical distribution system. The study shall be in accordance with applicable ANSI and IEEE Standards.

- B The study input data shall include the utility company's short-circuit single and three-phase contribution, with the X/R ratio, the resistance and reactance components of each branch impedance, motor and generator contributions, base quantities selected, and all other applicable circuit parameters.
- C Short-circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at each switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboards, and other significant locations through the system.
- D An equipment evaluation study shall be performed to determine the adequacy of circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing the short-circuit ratings of these devices with the available fault currents. Any problem area or inadequacies in the equipment shall be promptly brought to the Owner/Engineer's attention.

3.02 PROTECTIVE DEVICE COORDINATION STUDY

- A Coordination study shall be prepared for the electrical overcurrent devices to assure proper equipment and personnel protection.
- B The study shall present an organized time-current analysis of each protective device in series from the individual device back to the source. The study shall reflect the operation of each device during normal and abnormal current conditions.
- C The coordination study shall be prepared by qualified engineers of the switchgear Manufacturer, Electro-Test, Electrical Systems Analysis, Inc., Power Field Services, Inc., or approved. The contractor is responsible for providing all pertinent information required by the preparers to complete the study.
- D The complete study shall include a system one-line diagram and protective coordination curves.
- E Coordination curves shall be prepared to determine the required settings of protective devices to assure selective coordination. The curves shall graphically illustrate on log-log paper that adequate time separation exists between each protection device shall be plotted in such a manner that all upstream devices will be clearly depicted on one sheet. The following specified information shall also be shown on the coordination curves:
 - 1. Device identification.
 - 2. Voltage and current ratio for curves.
 - 3. 3-phase and 1-phase ANSI damage points for each transformer.
 - 4. No-damage, melting, and clearing curves for fuses.
 - 5. Cable damage curve.
 - 6. Transformer inrush points.
 - 7. Maximum short circuit cut-off point.
- F A table shall be developed to summarize the settings selected for the protective devices. Included in the table shall be the following:
 - 1. Device identification.
 - 2. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
 - 3. Fuse rating and type.
 - 4. Ground fault pickup and time delay.

END OF SECTION 26 05 75

SECTION 27 05 00**COMMON WORK RESULTS FOR COMMUNICATIONS****PART 1 GENERAL****1.01 WORK INCLUDED**

- A Furnish and install complete raceway system and backboards for telephone/data equipment and devices as noted on the Drawings.
- B Comply with TIA/EIA Standards 568-B, 569 and 607, latest edition.

1.02 REFERENCES

- A ANSI/TIA/EIA-568-B, Commercial Building Telecommunications Wiring Standard.
- B ANSI/TIA/EIA-569, Commercial Building Standard for Telecommunications Pathways and Spaces.
- C ANSI/TIA/EIA-606, Administration Standard for Telecommunications Infrastructure of Commercial Buildings.
- D ANSI/TIA/EIA-607, Commercial Building Grounding and Bonding Requirements for Telecommunications.
- E BICSI, Telecommunications Distribution Methods Manual, latest edition.

1.03 SUBMITTAL

- A Product Data.
- B Shop Drawings.
- C Installation and record drawings.

PART 2 PRODUCTS**2.01 COMPONENTS AND MATERIALS**

- A Wall Outlet Boxes: 4-inch square, 2 5/8-inch deep, minimum, with single-gang mud ring unless otherwise noted on the Drawings.
- B Conduits: 1-inch minimum size with larger sizes indicated on the Drawings. Provide PVC Schedule 40 with steel sweep ells for direct-buried conduit runs.
- C Backboards: 3/4-inch 8-foot high, fire rated fir plywood, width as shown on the Drawing.
- D Grounding busbar: 2-inch by 10-inch by 1/4-inch solid copper. Wall mount with insulated standoffs per TIA/EIA-607.

PART 3 EXECUTION**3.01 INSTALLATION**

- A Conduit bends shall be large radius field bends or factory ells. Cast type fittings or sharp bends shall not be installed unless specifically approved by the systems installer. No section of conduit shall be longer than 100 feet or contain more than 180 degrees of bend between pull points or pull boxes.
- B Where conduits are shown stubbed into a terminal area, stub 6 inches above floor or 12 inches down from ceiling at the appropriate terminal board location, terminating in insulating bushings.
- C Provide a pull wire in all conduits longer than 15 feet or with more than 90 degrees of bend.
- D Paint front and ends of all terminal boards with two coats of enamel to match interior color specified by the Architect.
- E Coordinate with system supplier for phasing and work scheduling.
- F The inside radius of a bend in conduit shall be at least 6 times the internal diameter. When the conduit size is greater than 2 inches, the inside radius shall be at least 10 times the internal diameter of the conduit.
- G Provide all low voltage conduit stub-outs with insulated bushings.
- H Unless otherwise noted on the drawings, provide #6CU ground minimum per telephone utility requirements.

END OF SECTION 27 05 00

SECTION 27 05 26
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL**1.01 DESCRIPTION**

- A The work covered by this section of the Specifications includes all labor necessary to perform and complete such construction, all materials and equipment incorporated or to be incorporated in such construction and all services, facilities, tools and equipment necessary or used to perform and complete such construction. The work of this section shall include, but is not limited to, the following:
1. Install a telecommunications grounding and bonding infrastructure.
 2. Bond all ladder rack segments and equipment racks/cabinets/frames to the ground bars in each telecommunications room.
 3. Bond all metallic/armored cable sheaths to the ground bars in each telecommunications room.

1.02 CODES AND STANDARDS

- A Codes: Refer to Specification Section 01 41 13.
- B Reference Standards: Refer to Specification Section 01 42 19.

1.03 SUBMITTALS

- A Also refer to Specification Section 01 33 23.
- B Shop Drawings:
1. Shop drawings shall show the locations where grounding conductors are to be run and where they are to be attached to equipment, cables within each telecommunications room.
- C Submit the following samples:
1. Jumpers used to bond ladder rack segments and equipment racks to the ground in each telecommunications room.
 2. Bonding clamps and jumpers used to bond armored cables to the ground bar.

PART 2 PRODUCTS**2.01 METALLIC CABLE SPECIFICATIONS**

- A Ground Wire for TBB: Non-Insulated grounding wire with a conductor size of Number 3/0 AWG copper wire. Wire must be UL listed.
1. Cable shall be:
 - a. Anaconda, Brand-Rex, Collyer, General Cable, Hatfield, Houston, Kaiser, Kerite, National, Okonite, Rome or Triangle
 - b. Or approved equal.
- B Bonding Conductor for Telecommunications: Insulated grounding wire with a minimum copper conductor size equal to that of the TBB, with PVC insulation. Must be UL listed.
1. Cable jacket marking: Must be legible and shall contain the following information:
 - a. Manufacturer's name.
 - b. Copper Conductor Gauge.
 - c. UL listing.
 2. Cable jacket shall be green with black lettering.
 3. Cable shall be:
 - a. Anaconda, Brand-Rex, Collyer, General Cable, Hatfield, Houston, Kaiser, Kerite, National, Okonite, Rome or Triangle
 - b. Or approved equal.

- C Ground Wire for connections within each Telecommunications Room not located within plenum spaces: Insulated grounding wire with a minimum copper conductor size of number 6 AWG, with PVC insulation. Must be UL listed.
 - 1. Cable jacket marking: Must be legible and shall contain the following information:
 - a. Manufacturer's name.
 - b. Copper Conductor Gauge.
 - c. UL listing.
 - 2. Cable jacket shall be green with black lettering.
 - 3. Wire shall be:
 - a. Anaconda, Brand-Rex, Collyer, General Cable, Hatfield, Houston, Kaiser, Kerite, National, Okonite, Rome or Triangle
 - b. Or approved equal.
- D Ground Wire for connections within each Telecommunications Room routed within plenum spaces: Non-Insulated grounding wire with a minimum copper conductor size of number 6 AWG. Must be UL listed.
 - 1. Wire shall be:
 - a. Anaconda, Brand-Rex, Collyer, General Cable, Hatfield, Houston, Kaiser, Kerite, National, Okonite, Rome or Triangle
 - b. Or approved equal.

2.02 CONNECTORS

- A Connector Terminal: Heavy duty, high copper alloy terminal for joining cable to grounding bus bar.
 - 1. Twin clamping elements for cable; two holes for attachment to grounding bar, etc.
 - 2. Burndy type KK###-2N series
 - 3. Cadweld type GL (B-122 series)
 - 4. Cadweld type LR
 - 5. Or Approved Equal.
- B Connector Terminal: Medium duty, high copper alloy terminal for joining cable to equipment racks, cable racking and cable tray.
 - 1. Twin clamping elements for cable; one (or more) holes for attachment to rack, tray, etc.
 - 2. Burndy type QQA series or VVA series, or approved equal.
 - 3. Burndy type QGFL series (only where pass through "daisy-chain" connection is indicated on drawings) or approved equal.
- C Cable to cable connector: Heavy duty, permanent connection by exothermic weld or irreversible compression connector between two or more copper conductors; splice "T" or cross, as indicated on the drawings and as required.
 - 1. As applicable: Burndy types YC-C or YGHC
 - 2. Cadweld types SS, TA, XA or XB
 - 3. Or Approved Equal.

2.03 BUSBARS

- A TMGB
 - 1. The TMGB shall
 - a. Be a predrilled copper busbar provided with holes for use with standard sized lugs.
 - b. Have minimum dimensions of ¼ in. thick x 4 in. wide x 20 in. long
 - c. Be NRTL listed.
 - d. Provided with insulators to electrically isolate busbar from mounting surface.
 - e. Provided with a minimum of 2 in. clearance from wall or other mounting surfaces for access.

- f. Chatsworth Part # 40153-020
 - g. Or Approved Equal
 - B TGB
 - 1. The TGB shall
 - a. Be a predrilled copper busbar provided with holes for use with standard sized lugs.
 - b. Have minimum dimensions of ¼ in. thick x 2 in. wide x 12 in. long
 - c. Be NRTL listed.
 - d. Provided with insulators to electrically isolate busbar from mounting surface.
 - e. Provided with a minimum of 2 in. clearance from wall or other mounting surfaces for access.
 - f. Chatsworth Part # 13622-012
 - g. Or Approved Equal

PART 3 EXECUTION

3.01 CABLE & WIRE INSTALLATION

- A General:
 - 1. The Contractor shall install each ground conductor (wire) as an uninterrupted conductor section between the designated termination points, unless otherwise directed by the installation specifications. There shall be no splices or mechanical couplers installed between the wire points of origin and termination except as shown on the Drawings and/or specified herein.
 - 2. Unless otherwise noted, all ground wires shall be routed through the telecommunications cable management pathways so as to achieve a “coupled bonding conductor” effect.
- B Required Grounding Connections:
 - 1. Provide and install one individual ground wire from each equipment rack/cabinet/frame (installed under this work) to the TGB in the room. Each conductor is to be “home run”; do not “daisy chain” the connections, except as may be indicated on the drawings.
 - 2. Provide and install one individual ground wire from the overhead ladder racking (installed under this work) to the TGB in the room.

3.02 CONNECTOR INSTALLATION

- A The Contractor shall furnish and install all ground wire connectors as shown on the Drawings or as indicated herein, unless otherwise noted.
- B Follow the connector manufacturer’s instructions for installing the connector to the cable and the connector to the cabinet/rack, ground bar, etc. Use the appropriate tools for the job, tighten nuts/bolts to proper torque, remove paint, insulation, oxidation as needed to assure good metal to metal contact, etc. If the manufacturer does not provide tightening specifications, follow the recommendations of UL Standard 486.

3.03 CABLE IDENTIFICATION

- A Label both ends of each ground conductor within 6 inches of a connector terminal or splice. Label the grounding conductors as shown on the Drawings.

3.04 QUANTITIES OF GROUND WIRE

- A Location and placement of grounding and bonding wires and components shall be as shown on the Drawings or defined herein.
- B Quantities of ground wires, bonding components, etc. shown on the drawings are illustrative only and are meant to indicate the general configuration of the work. The Contractor is responsible for providing the correct quantities of materials to construct a grounding and bonding system that meets the intent of these Specifications and the relevant codes.

3.05 CABLE TESTING

- A As a minimum, the Contractor shall test, as described below, all metallic wires and cables installed under these Specifications.
- B Test the grounding conductor and the terminal connectors for total resistance between the equipment item being grounded and the main telecommunications grounding point in the room. This resistance must be less than 0.25 Ohm.
- C Recommended test equipment (obtain approval of Owner/Engineer prior to using substitute test equipment):
 - 1. An ohmmeter capable of indicating resistance down to 10 milli-ohms or below.

3.06 ACCEPTANCE

- A Upon receipt of the Contractor's documentation of cable testing, the Owner/Engineer will review/observe the installation and randomly request tests of the cables/wires installed. Once the testing has been completed and the Owner/Engineer is satisfied that all work is in accordance with the Contract Documents, the Owner will notify the Contractor in writing.

3.07 RECORD DRAWINGS

- A Comply with Specification Section 01 78 39.
- B The Project Record Drawings shall show the types and locations of installed grounding and bonding conductors.

END OF SECTION 27 05 26

SECTION 27 05 53**IDENTIFICATION FOR COMMUNICATIONS SYSTEMS****PART 1 GENERAL****1.01 GENERAL**

- A Drawings and general provision of the Contract, including General and other Conditions and other General Requirements sections, apply to the work specified in this section.

1.02 WORK INCLUDED

- A Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.03 SCOPE

- A This section includes all telecommunications cables

1.04 QUALITY ASSURANCE

- A All cable identification tags shall be installed in a neat and workmanlike manner.

PART 2 PRODUCTS**2.01 LABEL TAGS**

- A The labels shall be machine generated.
- B The label background shall be white with black ink.
- C Lettering on sleeves shall be 1/8-inch high

PART 3 EXECUTION**3.01 INSTALLATION**

- A Cable - All horizontal/station cables will be labeled 4" from the termination at each end. The labels will conform to TIA/EIA -606A standard.

END OF SECTION 27 05 53

SECTION 28 05 00**COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY****PART 1 GENERAL****1.01 WORK INCLUDED**

- A Furnish and install complete raceway system and wiring for Electronic Safety and Security (ESS) equipment and devices as noted on the Drawings. Include necessary conductors, connectors, fittings, boxes, hangers and appurtenances.
- B Size raceways and conduits as specified. Where no size is indicated, conduit may be the minimum code permitted size for the quantity of conductors installed, based on NEC tables for conductors with type THW/TW insulation.
- C Size conductors as recommended by manufacturer.
 - 1. Comply with TIA/EIA Standards 569 and 607, latest edition.

1.02 REGULATORY REQUIREMENTS

- A Comply with the following codes and standards, latest adopted revision, including Oregon State amendments.
 - 1. International Building Code (IBC).
 - 2. National Electrical Code (NEC).
 - 3. National Fire Protection Association (NFPA).
 - 4. National Electrical Manufacturers Association (NEMA).
 - 5. National Electrical Contractors Association (NECA).
 - 6. American National Standards Institute (ANSI).
 - 7. Underwriters Laboratories (UL).

1.03 SITE VISITATION

- A The Contractor shall visit the site prior to bidding and become familiar with existing conditions and all other factors that may affect the execution of the work. Include all related costs in the initial bid proposal.

1.04 COORDINATION OF WORK

- A Coordinate with other trades for proper installation of all items of equipment. Consult the Drawings of all other trades or crafts to avoid conflicts with cabinets, counters, equipment, structural members, etc. In general, the architectural drawings govern but conflicts shall be resolved with the Architect prior to rough-in.
- B Verify the physical dimensions of each item of equipment to fit the available space. Coordination of the equipment to fit into the available space and the access routes through the construction shall be the Contractor's responsibility.
- C Coordinate rough-in and wiring requirements for all equipment provided. Make installation and connections in accordance with manufacturer's instructions. Doors and access panels shall be kept clear.

1.05 WARRANTY

- A Provide a written warranty covering the work done under this Division as required by the General Conditions.

PART 2 PRODUCTS**2.01 CONDUITS**

- A Galvanized Rigid Conduit (GRC): Smooth surfaced heavy wall mild steel tube of uniform thickness and temper, reamed and threaded at each end and protected inside and out with galvanizing, sherardizing, or equivalent process. GRC shall comply with NEC Article 346.

- B Intermediate Metallic Conduit (IMC): Smooth surface, intermediate wall mild steel tube of uniform thickness and temper, reamed and threaded at each end, and protected inside and out with galvanizing, sherardizing, or equivalent process. IMC shall comply with NEC Article 345.
- C Electrical Metallic Tubing (EMT): Smooth surface, thin wall mild steel tube of uniform thickness and temper, galvanized or sherardized on the outside, and enameled on the interior. EMT shall comply with NEC Article 348.
- D Flexible Conduits (Flex):
 - 1. Flexible Metallic Conduit: Interlocking single strip steel construction, galvanized inside and out after fabrication. Comply with NEC Article 350.
 - 2. Liquid Tight: Similar to flexible metallic conduit, except encased in a liquid tight polyvinylchloride or equivalent outer jacket over the flexible steel core. Comply with NEC Article 351.
- E Rigid Non-Metallic Conduit: Type II PVC Schedule 40, suitable for use with 90°C rated wire. Conduit shall conform to UL Standard 651 and carry appropriate UL listing for above and below ground use.

2.02 FITTINGS

- A GRC and IMC:
 - 1. Threaded Locknuts: Sealing type where used with NEMA 2, 3, 3R, 4 and 12 enclosures.
 - 2. Threaded Bushings: 1 1/4 inch and larger, insulated, grounding type as required under Section 26 05 26, Grounding and Bonding for Electrical Systems.
 - 3. Threaded Couplings: Standard threaded of the same material and as furnished with conduit supplied. Erickson type couplings may be used where required to complete conduit runs larger than 1 inch.
- B EMT:
 - 1. Connectors: Steel compression ring or steel set screw type for conduit termination, with insulated throat, suitable for conditions used. Use lay-in grounding type bushings where terminating grounding conductors.
 - 2. Couplings: Steel compression ring or steel set screw type, concrete tight.
- C Threadless: GRC and IMC couplings and box connectors may be steel threadless, compression ring or set screw type for use with conduits 1 inch and smaller where installed in poured concrete locations or where limited working space makes threaded fittings impractical.
- D Weatherproof Connectors: Threaded.
- E Expansion Couplings: Equal to O.Z. type EX with jumper.
- F Seal-Offs: With filler fiber, compound, and removable cover.

2.03 BOXES

- A Wall Outlet Boxes: 4-inch square, 2 5/8-inch deep, minimum, with single-gang mud ring unless otherwise noted on the Drawings.
- B Surface Outlet Boxes: Galvanized stamped steel same as above for use on ceilings; cast steel or aluminum with threaded hubs or bosses for use on walls.
- C Large Boxes: Boxes exceeding 4-11/16 inches square when required shall be welded steel construction with screw cover and painted, steel gauge as required by physical size, Hoffman, Circle AW or equal.
- D Systems: Boxes for systems devices shall be as recommended by the systems manufacturer, suitable for the equipment installed. Equip with grounding lugs, brackets, device rings, etc., as required.

2.04 POWER LIMITED WIRING

- A Copper, stranded or solid as recommended by the system manufacturer.
- B Insulation shall be appropriate for the system and location used.

PART 3 EXECUTION**3.01 INSTALLATION**

- A Conduit bends shall be large radius field bends or factory ells. Cast type fittings or sharp bends shall not be installed unless specifically approved by the systems installer. No section of conduit shall be longer than 100 feet or contain more than 180 degrees of bend between pull points or pull boxes.
- B Where conduits are shown stubbed into a terminal area, stub 6 inches above floor or 12 inches down from ceiling at the appropriate terminal board location, terminating in insulating bushings.
- C Provide a pull wire in all conduits longer than 15 feet or with more than 90 degrees of bend.
- D Protect all existing equipment and devices that will remain in service during construction from mechanical injury and dust entry.
 - 1. Coordinate with system supplier for phasing and work scheduling.
 - 2. The inside radius of a bend in conduit shall be at least 6 times the internal diameter. When the conduit size is greater than 2 inches, the inside radius shall be at least 10 times the internal diameter of the conduit. For fiber optic cable, the inside radius of a bend shall always be at least 10 times the internal diameter of the conduit.
 - 3. Provide all low voltage conduit stub-outs with insulated bushings.
 - 4. Conceal all conduits in finished spaces. Concealed conduits shall run in a direct line with long sweep bends and offsets. GRC and IMC embedded in concrete below grade or in damp locations shall be made watertight by painting the entire male thread with Rustoleum metal primer or equal before assembly.
 - 5. Route exposed conduit parallel or at right angles to structural building lines and neatly offset into boxes. Conduits attached directly to building surfaces shall closely follow the surfaces. Conduit fittings shall be used to "saddle" under beams. Drilling or notching of existing beams, trusses on structural members shall be coordinated with Architect prior to commencing.
 - 6. GRC and IMC terminations at boxes, cabinets, and general wiring enclosures shall be rigidly secured with double locknuts and bushings or approved fittings. Conduit shall be screwed in and shall engage at least five threads in hub where conduit boxes with threaded hubs or bosses are used. Insulating bushings shall be used for conduits 1-1/4 inches or larger.
 - 7. Keep conduit and raceways closed with suitable plugs or caps during construction to prevent entrance of dirt, moisture, concrete, or foreign objects. Raceways shall be clean and dry before installation of wire and at the time of acceptance.
 - 8. Pack spaces around conduits with polyethylene backing rods and seal with polyurethane caulking to prevent entrance of moisture where conduits are installed in sleeves or block-outs penetrating moisture barriers.

END OF SECTION 28 05 00

**SECTION 32 17 23
PAVEMENT MARKINGS**

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A Painted pavement markings.

1.02 REFERENCE STANDARDS

- A AASHTO M 247 - Standard Specification for Glass Beads Used in Pavement Markings 2013 (Reapproved 2018).
- B AASHTO MP 24 - Standard Specification for Waterborne White and Yellow Traffic Paints 2015 (Reapproved 2020).
- C FHWA MUTCD - Manual on Uniform Traffic Control Devices 2010, with Errata.

1.03 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Shop Drawings: Indicate survey control points and pavement markings.
- C Product Data: Manufacturer's data sheets on each product to be used.
- D Certificates: Submit for each batch stating compliance with specified requirements.
 - 1. Painted pavement markings.
- E Manufacturer's Instructions:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- F Installer's qualification statement.
- G Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Paint: 2 containers, 1 gallon (4 liter) size, of each type and color.
 - 3. Extra Markers: 5 percent, of each type and color.

1.04 QUALITY ASSURANCE

- A Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A Deliver paint in containers of at least 5 gallons (18 L) accompanied by batch certificate.
- B Store products in manufacturer's unopened packaging until ready for installation.

1.06 FIELD CONDITIONS

- A Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A Painted Pavement Markings:
 - 1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PAINTED PAVEMENT MARKINGS

- A Comply with State of Oregon Highway Department standards.
- B Comply with FHWA MUTCD.
- C Painted Pavement Markings: As indicated on drawings.
 - 1. Marking Paint: In accordance with AASHTO MP 24.
 - a. Parking Lots: White.
 - b. Symbols and Text: White.
 - c. Wheelchair Symbols: Provide blue and white.
 - 2. Reflective Glass Beads: Type 1, in accordance with AASHTO M 247.
 - 3. Obliterating Paint: Type I, in accordance with AASHTO MP 24.

- a. Bituminous Pavement: Black.
- b. Concrete Pavement: Gray.

PART 3 EXECUTION**3.01 EXAMINATION**

- A Identify existing markings for removal.
- B Verification of Conditions: Verify that pavement is dry and ready for installation.
- C Notify Architect of unsatisfactory conditions before proceeding.

3.02 PREPARATION

- A Establish survey control points for locating and dimensioning of markings.
- B Clean surfaces prior to installation.
 - 1. Remove dust, dirt, and other debris.
- C Apply paint stencils by type and color at necessary intervals.

3.03 INSTALLATION

- A General:
 - 1. Position pavement markings as indicated on drawings.
 - 2. Field location adjustments require approval of Architect.
- B Painted Pavement Markings:
 - 1. Apply in accordance with manufacturer's instructions.
 - 2. Apply in accordance with State of Oregon Highway Department standards.
 - 3. Apply in accordance with FHWA MUTCD standards.
 - 4. Obliterating Paint: Apply as necessary to cover existing markings completely.
 - 5. Marking Paint: Apply uniformly, with sharp edges.
 - a. Applications: One coat.
 - b. Wet Film Thickness: 0.015 inch (0.4 mm), minimum.
 - c. Stencils: Lay flat against pavement, align with striping, remove after application.
 - d. Glass Beads: Apply directly to paint, 10 second lag time, 6 lbs/gal (720 g/L) of paint, uniform thickness and coverage.

3.04 FIELD QUALITY CONTROL

- A See Section 01 40 00 - Quality Requirements for additional requirements.
- B Perform field inspection for deviations from true alignment or material irregularities.
- C If inspections indicate work does not meet specified requirements, rework and reinspect at no cost to Owner.
- D Allow the pavement marking to set at least the minimum time recommended by manufacturer.

3.05 PROTECTION

- A Replace damaged or removed markings at no additional cost to Owner.
- B Preserve survey control points until pavement marking acceptance.

END OF SECTION 32 17 23

ASBESTOS ABATEMENT CONTRACTOR BID DOCUMENT AND SPECIFICATIONS

**Kinnaman Elementary School
Security Upgrade and Classroom Walls Project
4205 SW 193rd Avenue
Beaverton, OR 97078**

Prepared for:

**Beaverton School District
16550 SW Merlo Road
Beaverton, Oregon 97006**

Submitted: October 13, 2022

Prepared By:



**4105 SE International Way, Suite 505
Milwaukie, OR 97222
503.387.3251**

TRC Project Number: **515789**

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Appendices

Figures

- Figure 1 – Asbestos Abatement Materials Location Map

Appendix A – LIMITED ASBESTOS SURVEY REPORT

BID FORM

1. Base Bid: Bid due date will be announced at the Job Walk

The undersigned, having examined the proposed contract documents titled: Asbestos Abatement Contractor Bid Document and Specifications for 4205 SW 193rd Avenue in Beaverton, Oregon 97078 (Project Site), dated October 13, 2022, and having visited the site and examined the conditions affecting the work, hereby proposes and agrees to furnish all labor, materials, equipment, permits, insurance, appliances and regulatory fees to perform operations necessary to complete the work as required by said proposed contract documents, for that portion of the work identified in Scope of Work as “Base Bid” for the stipulated sum of:

_____ **DOLLARS (\$_____)**

To be completed in _____ working days (8 hr. shifts).

Unit Abatement Costs: Removal as ACM and disposal as applicable by regulations:

Material	Unit	Unit Cost
Gypsum Board, Joint Compound & Texture	Square Foot	\$/sq. ft.:
Vinyl Floor Tile and Mastic	Square Foot	\$/sq. ft.:
Thermal System Pipe Insulation (Elbows)	Each	\$/ each:
Thermal System Pipe Insulation (Runs)	Linear Foot	\$/ln. ft.:
Fire Doors	Each	\$/ Each
Mobilization Cost Associated with Follow-up Abatement Services	Mobilization	\$/Mob

BIDDER

by _____

Address _____

Contractor License _____

License Type _____

Type of business entity:

Individual partners or individuals of the firm:

President of Corporation _____

Secretary of Corporation _____

Corporation is organized under laws of the State of _____

Bid dated this _____ day of _____, 2022.

END OF BID FORM

ASBESTOS CONTAINING MATERIALS ABATEMENT SUMMARY OF WORK

The Work includes the abatement of Asbestos Containing Materials (ACM) at 4205 SW 193rd Avenue, Beaverton, Oregon in order to prepare the site for renovation. The scope of work includes abatement and proper disposal of the asbestos containing materials identified in this document.

Base Bid: The Asbestos Abatement Contractor shall furnish all labor, materials, services, insurance (specifically covering the handling, transportation of asbestos containing material (ACM) and equipment which is specified, shown, or reasonably implied for the following abatement work.

The removal and disposal as required by applicable regulations, of the following friable asbestos containing materials identified in the Limited Asbestos Survey report prepared by TRC and dated December 12, 2018. The asbestos-containing materials to be abated and their general location(s) are as follows:

Asbestos Containing Materials

Description	Material Location(s)	Friable / non-Friable	Approximate Quantity
Drywall, Joint Compound, White Texture & Tan Wall Paper	Various Locations (See Figure 1)	Friable	29,600 SF

ASBESTOS

PART 1 GENERAL - ASBESTOS

1.01 SCOPE OF WORK

- A. The asbestos abatement and disturbance work related to this Project will consist of the removal and disposal of asbestos containing materials (ACM) and presumed asbestos containing materials (PACM) within portions of Kinnaman Elementary School located at 4205 SW 193rd Avenue in Beaverton, Oregon 97078 as part of a planned renovation project. This section is intended to provide instruction for requirements in connection with asbestos abatement or disturbance and is complementary to the other contract documents, which apply to this section by reference.
- B. For Work described in this Section, the Abatement Contractor (Contractor) shall furnish all labor, materials, equipment, tools, and any other resources necessary to complete the work in accordance with regulatory requirements and project contract documents, using best available technology and industry standard methods and procedures. The work shall include but not be limited to the removal and proper disposal of ACM and/or presumed ACM (PACM) materials as described below:

Asbestos Containing Materials

Description	Material Location(s)	Friable / non-Friable	Approximate Quantity
Drywall, Joint Compound, White Texture & Tan Wall Paper	Various Locations (See Figure 1)	Friable	29,600 SF

Please refer to Appendix A, Limited Asbestos Survey Report dated, December 12, 2018, for additional and more detailed information on the asbestos materials present at the Site.

Estimated quantities are provided as an approximate guide to the Contractor. The material quantities listed above are approximations and TRC is not responsible for the accuracy of the quantities and measurements provided. The Contractor shall field verify material quantities, locations, and make themselves cognizant of existing field conditions prior to submitting bids for the work of this specification. Submitting of bids for work described herein shall take into consideration and utilize the Contractor's field measurements of materials and observations of the conditions verified on site.

- C. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor, equipment, and materials necessary to perform the Work.
- D. All Work shall be performed in strict accordance with the Project Documents and all governing codes, rules, and regulations. Where conflicts occur between the Project Documents and applicable codes, rules, and regulations, the more stringent requirement shall apply.
- E. Working hours shall be as required and approved by the Owner. ERM abatement activities including, but not limited to, work area preparation, gross removal activities, waste clean-up activities, waste removal, etc. may need to be performed during the specified time period by the Owner. The Contractor shall coordinate and schedule all Work with the facility and Owner's representative.

1.02 PERMITS AND COMPLIANCE

- A. The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State, and local laws, rules, and regulations pertaining to Work practices, protection of Workers, authorized visitors to the site, persons, and property adjacent to the Work.
- B. Perform asbestos related Work in accordance with Federal, State and Local Regulations (U.S. Environmental Protection Agency (EPA) 40 CFR 61, Occupational Health and Safety (OSHA) 29 CFR 1926 and Oregon Department of Environmental Quality (ODEQ)). Where more stringent requirements are specified, the Contractor shall adhere to the more stringent requirements.

1.03 SUBMITTALS

- A. Pre-Work Submittals: Within 15 calendar days prior to the pre-construction conference, the Contractor shall submit copies of the documents listed below to Beaverton School District's Environmental Consultant for review and approval prior to the commencement of asbestos abatement activities:

1. Asbestos Removal Work Plan which includes the means, methods and protective measures which will be used to comply with all applicable Federal, State and Local rules and regulations. This plan shall be completed and signed by an EPA accredited Asbestos Project Designer.
2. Current worker and contractor/supervisor training records.
3. Insurance Certificates
 - a. All Certificates of Insurance must name Beaverton School District as additional insured and will comply with entities noted in the contract as additional insured. These include the following:
 - Asbestos/Pollution Liability - \$1,000,000;
 - Auto Liability - \$1,000,000 per each vehicle on site;
 - Workman's Compensation and Employers Liability - \$500,000 per accident;
 - Commercial General Liability - \$1,000,000 per occurrence with \$2,000,000 general aggregate per project
 - True Umbrella Policy - \$5,000,000
 - b. All insurance will be written through companies having an A.N. rating of at least A VII or with such other companies as may reasonably be approved by Owner. All such liability insurance maintained by the Contractor or any subcontractor will include the condition that it is primary and that any such insurance maintained by Owner or any other additional insured is excess and non-contributory.
- B. On-Site Submittals: Refer to Part 3.01.C for all submittals, documentation, and postings required to be maintained on-site during abatement activities.
- C. Project Close-out Submittals: Within 30 business days of the completion of the project, the Contractor shall submit digital and hard copies of the documents listed below. The documents shall be transmitted to the Environmental Consultant for review and approval prior to the Contractor's final payment.
 1. Originals of all waste disposal manifests, seals, and disposal logs.
 2. OSHA personal air monitoring results conducted during the Work.
 3. Daily progress log describing in detail the areas of work and ACM/PACM affected by the day's work activities and regulated work area entry/exit logs
 4. Project Notifications
 5. Safety Meeting Logs
 6. Insurance Certificates
 7. Workers Certifications and Medical Monitoring

8. Contractors Licenses

1.04 PRE-CONSTRUCTION CONFERENCE

- A. Prior to start of preparatory Work under this Contract, the Contractor shall attend a pre-construction conference attended by Owner, Architect and Environmental Consultant.
- B. Agenda for this conference shall include but not necessarily be limited to:
 - 1. Contractor's Asbestos Removal Work Plan
 - 2. Environmental Consultant's duties and functions
 - 3. Contractor's Work procedures including:
 - a. Methods of job site preparation and removal methods
 - b. Respiratory protection
 - c. Disposal procedures
 - d. Cleanup procedures
 - e. Fire exits and emergency procedures
 - 4. Contractor's required pre-work and on-site submittals, documentation, and postings
 - 5. Contractor's plan for twenty-four (24) hour project security both for prevention of theft and for barring entry of unauthorized personnel into work areas
 - 6. Temporary utilities
 - 7. Storage of removed asbestos containing materials
 - 8. Waste disposal requirements and procedures, including waste manifest and container seals
- C. In conjunction with the conference the Contractor shall accompany the Owner, Architect and Environmental Consultant on a pre-construction walk-through of the Project site.

1.05 APPLICABLE STANDARDS AND REGULATIONS

All asbestos related work must be performed in accordance with EPA and OSHA regulations (40 CFR 61, 29 CFR 1926) and Oregon Department of Environmental Quality. Where more stringent requirements are specified, the Contractor shall adhere to the more stringent requirements.

1.06 NOTICES

- A. The Contractor shall provide notification of intent to commence asbestos abatement activities at least ten (10) working days prior to beginning abatement activities. Written notification shall be sent to the Oregon Department of Environmental Quality Department (DEQ).
- B. The Contractor shall maintain copies of notices, and provide proof of delivery and receipt.

- C. The Contractor shall be responsible for maintaining current project filings with regulatory agencies for the duration of the project.

1.07 ENVIRONMENTAL CONSULTANT

- A. The Owner shall engage the services of an Environmental Consultant (the Consultant) who shall serve as the Owner's Representative in regard to the performance of the asbestos abatement Project and provide direction as required throughout the entire abatement Project period.
- B. The Contractor is required to ensure cooperation of its personnel with the Consultant for the air sampling and Project monitoring functions described in this section. The Contractor shall comply with all direction given by the Consultant during the course of the Project.
- C. The Consultant shall review and approve all Contractor submittals.
- D. The Consultant shall staff the Project with a trained and certified person(s) to act on the Owner's behalf at the job site.
 - 1. The consultant's representative shall be on-site at all times the Contractor is on-site. The Contractor shall not be permitted to conduct any Work unless the consultant's representative is on-site (except for inspection of barriers and negative air system during non-working days).
 - 2. The consultant's representative shall have the authority to direct the actions of the Contractor verbally and in writing to ensure compliance with the Project documents and all regulations. The consultant's representative shall have the authority to Stop Work when gross Work practice deficiencies or unsafe practices are observed, or when ambient fiber concentrations outside the removal area exceed 0.01 f/cc or background level.
 - a. Such Stop Work order(s) shall be effective immediately and remain in effect until corrective measures have been taken and the situation has been corrected.
 - b. Standby time required to resolve the situation shall be at the Contractor's expense.
 - 3. The consultant's representative shall provide the following services:
 - a. Inspection of the Contractor's Work, practices, and procedures, including temporary protection requirements, for compliance with all regulations and Project specifications including provisions required by Variances, the Work Place Safety Plan and Asbestos Work Permit.
 - b. Provide abatement Project air sampling as required by applicable regulations and the Owner. Sampling will include background, work area preparation, asbestos handling, final cleaning and clearance air sampling.
 - c. Verify daily that all Workers used in the performance of the Project are certified by the appropriate regulatory agency.

- d. Monitor the progress of the Contractor's Work, and report any deviations from the schedule to the Owner.
 - e. Monitor, verify, and document all waste load-out operations.
 - f. Verify that the Contractor is performing personal air monitoring daily, and that results are being returned and posted at the site as required.
 - g. The consultant's representative shall maintain a log on site that documents all project related and Consultant and Contractor actions, activities, and occurrences.
4. The following minimum inspections shall be conducted by the consultant's representative. Additional inspections shall be conducted as required by Project conditions. Progression from one phase of Work to the next by the Contractor is only permitted with the written approval of the consultant's representative.
- a. Pre-Construction Inspection: The purpose of this inspection is to verify the existing conditions of the Work Areas and to document these conditions.
 - b. Pre-Commencement Inspection: The purpose of this inspection is to verify the integrity of each containment system prior to disturbance of any asbestos containing material. This inspection shall take place only after the Work Area is fully prepped for removal.
 - c. Work Inspections: The purpose of this inspection is to monitor the Work practices and procedures employed on the Project and to monitor the continued integrity of the containment system. Inspections within the removal areas shall be conducted by the consultant's representative during all preparation, removal, and cleaning activities at least twice every Work shift. Additional inspections shall be conducted as warranted.
 - d. Pre-Encapsulation Inspection: The purpose of this inspection is to ensure the complete removal of ACM and/or PACM, from all surfaces in the Work Area prior to encapsulation.
 - e. Visual Clearance Inspection: The purpose of this inspection is to verify that: all materials in the scope of work have been properly removed; no visible asbestos debris/residue remains; no pools of liquid or condensation remains; and all required cleanings are complete. This inspection shall be conducted before final air clearance testing.
 - f. Post-Clearance Inspection: The purpose of this inspection is to ensure the complete removal of ACM, including debris, from the Work Area after satisfactory final clearance sampling and removal of all isolation and critical barriers and equipment from the Work Area.
- E. The Consultant shall provide abatement Project air sampling and analysis as required by applicable regulations. Sampling will include background, work area preparation, asbestos handling, and final cleaning and clearance air sampling.
1. Unless otherwise required by applicable regulations, the Consultant shall have samples analyzed by Phase Contrast Microscopy (PCM) for daily area and final clearance air

monitoring during asbestos removal or disturbance work. Results shall be available at the Project site within 2 hours of completion of sampling. Should TEM analysis be requested/required, results will be provided within 24 hours of receipt of samples by the accredited laboratory.

2. Samples shall be collected as required by applicable regulations and these specifications.
3. If the air sampling during any phase of the abatement project reveals airborne fiber levels at or above .01 fibers/cc or the established background level, whichever is greater, outside the regulated Work Area, Work shall stop immediately and corrective measures required by applicable regulations shall be initiated. Notify all employers and occupants in adjacent areas. The Contractor shall bear the burden of any and all costs incurred by this delay.
4. At the completion of each abatement phase, the Consultant shall prepare an interim certificate of completion for project records.

1.08 PERSONAL AIR SAMPLING

- A. The Contractor shall perform appropriate personal air monitoring in accordance with 29 CFR 1926.1101, every Work shift in each Work Area during which abatement activities occur in order to determine that appropriate respiratory protection is being worn and utilized.
- B. The Contractor shall conduct air sampling that is representative of both the 8-hour time weighted average and 30-minute short-term exposures to indicate compliance with the permissible exposure and excursion limits.
- C. The Contractor's laboratory analysis of air samples shall be conducted by laboratory accredited by the American Industrial Hygiene Association (AIHA) for PCM analysis.
- E. Results of personnel air sample analyses shall be available within 5 business days of sample collection.

1.09 PROJECT SUPERVISOR

- A. The Contractor shall designate a full-time Project Supervisor who shall meet the following qualifications:
 1. The Project Supervisor shall hold an Asbestos Hazard Emergency Response Act (AHERA) certification as an Asbestos Contractor/Supervisor.
 2. The Project Supervisor shall meet the requirements of a "Competent Person" as defined by OSHA 1926.1101 and shall have a minimum of one year experience as a supervisor.
 3. The Project Supervisor must be able to speak, read, and write English fluently, as well as communicate in the primary language of the Workers and immediate community.

- B. The Project Supervisor shall be responsible for the performance of the Work and shall represent the Contractor in all respects at the Project site. The Supervisor shall be the primary point of contact for the Asbestos Project Monitor.

1.10 RESPIRATORY PROTECTION

- A. Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services.
- B. High Efficiency Particulate Air (HEPA) respirator filters shall be approved by NIOSH and shall conform to the OSHA requirements in 29 CFR 1910.134 and 29 CFR 1926.1101.
- C. A storage area for respirators shall be provided by the Contractor in the clean room side of the personnel decontamination enclosure where they will be kept in a clean environment.
- D. The Contractor shall provide and make available a sufficient quantity of respirator filters so that filter changes can be made as necessary during the work day. Filters used with negative pressure air purifying respirators shall be changed regularly to comply with OSHA.
- E. Any visitor, Worker, or supervisor found in the Work Area not wearing the required respiratory protection shall be removed from the Project site.

1.11 DELIVERY AND STORAGE

- A. Store all materials at the job site in a suitable and designated area.
 - 1. Store materials subject to deterioration or damage away from wet or damp surfaces and under cover.
 - 2. Protect materials from unintended contamination and theft.
 - 3. Storage areas shall be kept clean and organized.
- B. Remove damaged or deteriorated materials from the job site. Materials contaminated with asbestos shall be disposed of as asbestos debris.

1.12 TEMPORARY UTILITIES

- A. Shut down and lock out all electrical power to the asbestos Work Areas.
- B. Provide temporary electric service with Ground Fault Circuit Interrupters (GFCI) for all electric requirements within the asbestos Work Area.
- C. Provide temporary lighting with "weatherproof" fixtures for all Work Areas.
- D. Utilize domestic water service, if available, from Owner's existing system. Provide hot water heaters with sufficient capacity to meet Project demands.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All materials shall be delivered to the job site in the original packages, containers, or bundles bearing the name of the manufacturer, the brand name and product technical description, with Safety Data Sheets (SDSs) as applicable.
- B. No damaged or deteriorating materials shall be used. If material becomes contaminated the material shall be decontaminated or disposed of as asbestos-containing waste material. The cost to decontaminate and dispose of this material shall be at the expense of the Contractor.
- C. Fire retardant polyethylene sheet shall be in roll size to minimize the frequency of joints, with factory label indicating no less than six (6) mil thickness.
- D. Polyethylene disposable bags shall be no less than six (6) mils thick.
- E. A commercial grade duct tape (or equivalent) capable of sealing joints in adjacent polyethylene sheets and for the attachment of polyethylene sheets to finished or unfinished surfaces must be capable of adhering under both dry and wet conditions.
- F. Any planking, bracing, shoring, barricades and/or temporary sheet piling, necessary to appropriately perform work activities shall conform to all applicable federal, state and local regulations.

2.02 TOOLS AND EQUIPMENT

The Contractor shall provide tools and equipment that are suitable for asbestos related activities and in good working order.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. The following submittals, documentation, and postings shall be maintained on-site by the Contractor during abatement activities:
 - 1. Asbestos worker and contractor/supervisor certification cards for each person employed in the removal, handling, or disturbance of asbestos
 - 2. Daily OSHA personal air monitoring results
 - 3. Project documents (specifications and drawings)
 - 4. Applicable regulations
 - 5. Safety Data Sheets of supplies/chemicals used on the Project

6. Approved Abatement Work Plan
 7. List of emergency telephone numbers
 8. Daily Project Log
- B. The following documentation shall be maintained on-site by TRC Environmental Corp. during abatement activities:
1. Air sample results
 2. Project Monitor Daily Log
 3. Asbestos Survey Report
 4. A copy of ASTM Standard E1368 “Standard Practice for Visual Inspection of Asbestos Abatement Projects”
- C. Install emergency exit signage and fire extinguishers throughout the Work Area in accordance with OSHA Construction Industry Standards.
- D. Use the following engineering controls and work practices for all asbestos abatement operations, regardless of measured exposure levels:
1. Vacuum cleaners equipped with HEPA filters to collect all asbestos-containing dust and debris
 2. Wet methods to control exposures during asbestos removal and clean-up, except where proven to be infeasible
 3. Prompt clean-up and disposal of asbestos-contaminated wastes and debris in leak-proof containers
- F. Do not use any of the following equipment or work practices during asbestos abatement operations, regardless of measured exposure levels:
1. High-speed abrasive disc saws not equipped with point-of-cut HEPA ventilation or HEPA filtered exhaust air enclosures
 2. Blowing with compressed air to remove asbestos-containing materials
 3. Dry sweeping, shoveling, or other dry methods to clean up asbestos-containing dust and debris
 4. Employee rotation as a means of reducing employee exposure to asbestos
- G. Protect adjacent areas, materials and surfaces from damage due to demolition operations, including but not necessarily limited to the following:
1. Water damage

2. Dirt, dust and debris
3. Abrasion
4. Cuts and scratches
5. Holes from fasteners for temporary barriers

3.02 PROTECTIVE CLOTHING

- A. Provide personnel utilized during the Project with disposable protective whole body clothing, head coverings, gloves and foot coverings. Provide disposable plastic or rubber gloves to protect hands. Cloth gloves may be worn inside the plastic or rubber for comfort, but shall not be used alone. Make sleeves secure at the wrists and make foot coverings secure at the ankles by the use of tape, or provide disposable coverings with elastic wrists or tops.
- B. Authorized visitors shall be provided with suitable protective clothing, headgear, eye protection, and footwear whenever they enter the Work Area.

3.03 SIGNS AND LABELS

- A. Provide warning signs and barrier tapes at all approaches to asbestos Work Areas. Locate signs at such distance that personnel may read the sign and take the necessary protective steps required before entering the area.
 1. Provide danger signs in vertical format conforming to 29 CFR 1926.1101, minimum 20" x 14" displaying the following legend.

ASBESTOS CANCER AND LUNG DISEASE
HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA

2. Provide 3" wide OSHA-Approved barrier tape printed with black lettered, "DANGER ASBESTOS REMOVAL". Locate barrier tape across all corridors, entrances and access routes to asbestos Work Area. Install tape 3' to 4' Above Finished Floor AFF.
- B. Provide asbestos danger labels affixed to all asbestos materials, scrap, waste, debris and other products contaminated with asbestos.
 1. Provide asbestos danger labels of sufficient size to be clearly legible, displaying the following legend:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

2. Provide the following asbestos labels, of sufficient size to be clearly legible, for display on waste containers (bags or drums) which will be used to transport asbestos

contaminated material in accordance with United States Department of Transportation 49 CFR Parts 171 and 172: (Note: Include “RQ” for friable asbestos waste only.)

RQ, (WASTE) ASBESTOS, 9, NA2212, PGIII

3. Generator identification information shall be affixed to each waste container indicating the following printed in indelible ink:
 - Generator Name
 - Facility Name
 - Facility Address
 - EPA Generator ID Number

3.04 FRIABLE ACM REMOVAL BY FULL ENCLOSURE METHOD

A. Preparation of the Work Area

1. Install critical barriers over each opening into the regulated area. The following requirements are in addition to, not in lieu of, other indicated surface and object protection requirements:
 - a. Seal each opening between the work area and adjacent areas with not less than 2 layers of 6-mil polyethylene sheeting. Use an expanding-polyurethane foam gun to seal areas with large numbers of pipes, conduits and beams. Openings include, but are not necessarily limited to, windows, skylights, doorways, elevator hoist way openings, corridor entrances, drains, ducts, grills, grates, and diffusers.
 - b. Seal intake and exhaust vents and duct seams within the regulated area with not less than 2 layers of 6-mil polyethylene sheeting.
2. HVAC System Shutdown: Owner's maintenance personnel will shut down heating, cooling, and air conditioning systems when necessary. Coordinate scheduling with Owner's personnel.
3. Protection of Surfaces and Objects: The following requirements are in addition to, not in lieu of, indicated work area sealing requirements. Cover the following surfaces and objects as follows:
 - a. Protect all surfaces beneath all removal activity. Remove moveable objects from the work area, and cover fixed objects with impermeable drop cloths or plastic sheeting with edges securely sealed with tape.
 - b. Provide clean, fresh air to mechanical equipment, where required to maintain proper performance of equipment.
 - c. Fully pre-clean all covered surfaces with amended water and a HEPA vacuum.
 - d. Cover walls with not less than 2 layers of 6-mil polyethylene sheeting. Construct free-standing enclosure walls of not less than 6-mil polyethylene sheeting, with supports spaced not more than 3 feet on center.

- e. Cover floors with not less than 2 layers of 6-mil polyethylene sheeting. Avoid seams where possible. If seams are necessary, overlap not less than 12 inches and tape joints. Extend sheeting 12 inches up the side walls leaving no seams at the wall and floor joint. Immediately repair punctures and leaks, and clean up seepage.
- 4. Cleaning: Do not use cleaning methods that raise dust, such as sweeping or using vacuum cleaners not equipped with HEPA filters. Do not disturb asbestos materials during pre-cleaning phases. Treat water removed from the enclosure as asbestos contaminated waste. Fully seal floor drains.
- 5. Deactivate or install ground-fault circuit interrupters on each electrical circuit within the enclosure.
- 6. Construct a three-chambered decontamination facility that is adjacent to and connected to the regulated area, and that consists of a dirty room, a shower room, and a clean room in series. Construct decontamination facilities that are exposed to weather of lumber and exterior grade plywood. Secure the facility when not in use.
 - a. Supply the equipment room with properly labeled, impermeable bags and containers for the containment and disposal of contaminated protective equipment.
 - b. Construct showers that comply with the requirements of 29 CFR 1910.141 (d) (3), with the shower room adjacent to both the equipment room and the clean room. Filter water waste and shower water through a 5 micron filter, or remove water from site as asbestos waste.
 - c. Equip the clean room with a locker or appropriate storage container for each employee.
- 7. Employee Decontamination Facilities
 - a. Access the work area only through an approved decontamination system. Lock or block other entrances. Seal emergency exits (for use during a fire or accident) with polyethylene sheeting and tape.
 - b. Seal the waste pass-out, except during the removal of asbestos waste from the enclosure.
 - c. Entrance to The Regulated Area: Employees shall enter the decontamination area through the clean room, remove and store clothing, and put on protective clothing and respiratory protection before passing through to the equipment room.
 - d. Exit from The Regulated Area: Employees shall exit the regulated area by removing gross contamination and debris from their protective clothing. The clothing shall be removed and disposed of in the equipment room into labeled impermeable bags or containers. Employees shall then shower and enter the clean room before changing into street clothes.
- 8. Local Exhaust Ventilation: Maintain portable air filtration units with a HEPA filter in use during asbestos abatement operations requiring enclosures. Units shall conform to

OSHA Standard 1926.1101, Appendix F, and shall be designed in accordance with 40 CFR 61, Subpart M, Section 61.153.

- a. Exhaust directly to building exterior. Provide a backup portable air filtration unit at each removal enclosure. Startup ventilation units prior to initiating asbestos removal operations and run until the Owner's consultant has approved their shut-down after cleaning, visual inspection, clearance sampling and tear-down.
 - b. Direct air movement within the enclosure away from the employees' work area and toward the air filtration device.
 - c. Provide not less than 4 air changes per hour within the enclosure.
 - d. Within the enclosure, through the period of its use, maintain a pressure differential of not less than minus 0.02 water gage with respect to ambient conditions outside the enclosure. Provide continuous measurement of the pressure differential at each negative pressure enclosure.
9. Visually inspect the enclosure for breeches and smoke-test for leaks before work begins, and before the start of each work shift. Make all modifications to the enclosure prior to starting removal work.

B. Work Practices

1. Immediately preceding asbestos removal, apply a fine mist of water to the asbestos materials and the surrounding area. Keep surrounding areas wet by spraying periodically with amended water. Maintain a high humidity environment to assist in fiber settling.
2. Remove asbestos material using two-person teams, on staging platforms, if necessary.
3. Remove the wet asbestos material as intact sections or components. Carefully lower the material to the floor or place directly into container. Never drop or throw asbestos material on the floor.
4. At working heights between 15 and 50 feet above the floor, place removed asbestos materials in containers at the elevated levels and lower to floor, or place onto inclined chutes or scaffolding for subsequent collection and placement into containers. Clean all debris at the completion of each workday.
5. Once the asbestos material is at ground level, pack in labeled 6-mil polyethylene bags, wet and, if appropriate, hold in drums prior to starting the next section.
6. Use 2 sealed and labeled 6-mil thick bags for storage and transportation of asbestos waste. Standing water shall be in each bag
7. Wrap large components removed intact in two layers of 6-mil polyethylene sheeting, label, and secure with tape for transport to the landfill. Comply with all wetting requirements.

8. Treat wires, hangers, steel bands, nails, screws, metal lath, tin sheeting, and similar sharp objects removed with asbestos material as asbestos waste. Place in drums for disposal.
9. Label containerized asbestos waste in accordance with OSHA, EPA, and Department of Transportation regulations, as follows:
 - a. Label each container with OSHA label that contains the following information:

**DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG
DISEASE HAZARD**
 - b. Label each container with Owner's and Asbestos Abatement Firm's names and addresses as required by NESHAP.
 - c. Label each container with Class 9 Label required by DOT and identify waste as "RQ, Asbestos NA 2212."
10. Remove containerized asbestos waste daily from site, or store on site in a locked or secured location until ready for final disposal. Obtain approval of Owner's Representative of the location of disposal containers. Outdoor waste containers shall be fully enclosed and locked. Mark vehicles used to transport waste during the loading and unloading of asbestos waste with a visible sign, as required by NESHAP.

3.05 REMOVAL OF NON-FRIABLE ASBESTOS-CONTAINING MATERIALS

A. Removal of Vinyl Floor Tile (unless rendered Friable)

1. Prior to removal, critical barriers shall be placed over openings to the regulated area.
2. Prior to removal, clean floors of dirt and debris with vacuums equipped with HEPA filter.
3. Sanding the floor or related backing is not permitted.
4. Mechanical chipping of vinyl floor tile is prohibited, except when performed in a negative pressure enclosure.
5. Thoroughly wet vinyl floor tile with water. Use a slip scraper or equivalent to loosen the floor tile from the floor. Remove the floor tile in an intact state. Keep the floor tile wet throughout the removal and cleanup.
6. Place the resilient flooring material and debris in an asbestos disposal bag. Seal the bag and place it in a properly labeled drum. Comply with the disposal and labeling requirements of this document.

B. Asbestos Mastic Removal

1. Use bead blasting or grinding methods and follow friable removal requirements established in Section 3.04 above.
2. Properly dispose of all asbestos waste according to all applicable regulations, and comply with the disposal and labeling requirements of this Section.

C. Asbestos-Containing Siding and Transite Panels

1. Create a regulated work area and place impermeable drop cloths on surfaces beneath removal activity.
2. Cutting, abrading, or breaking material is not permitted.
3. Wet material with water prior to removal.
4. Carefully disassemble material such a manner as to prevent breakage.
5. Wrap and seal material in two layers 6-mil thick polyethylene, asbestos disposal bags, or equivalent. Seal bags or packages and properly label them with appropriate asbestos warning signs.

D. Non-Friable Asbestos Containing Exterior Sealant, Caulk, Putty and Window Glazing

1. Create a regulated work area and place impermeable drop cloths on surfaces beneath removal activity.
2. Any existing loose material shall be HEPA vacuumed prior to removal.
3. The material shall be thoroughly wetted prior to and during its removal.
4. The material should be removed as intact as possible. Manual methods shall be used.
5. Removed ACM shall be immediately bagged.
6. The removal of windows and other whole building components without disturbing the asbestos is encouraged.
7. If the material becomes friable during the abatement process, comply with the requirements for friable asbestos removal.

3.06 WORK AREA DECONTAMINATION AND CLEARANCE PROCEDURES

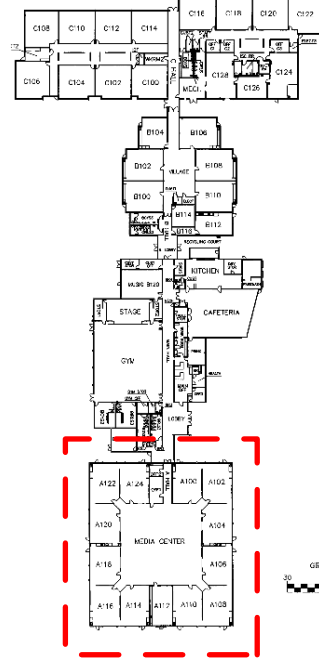
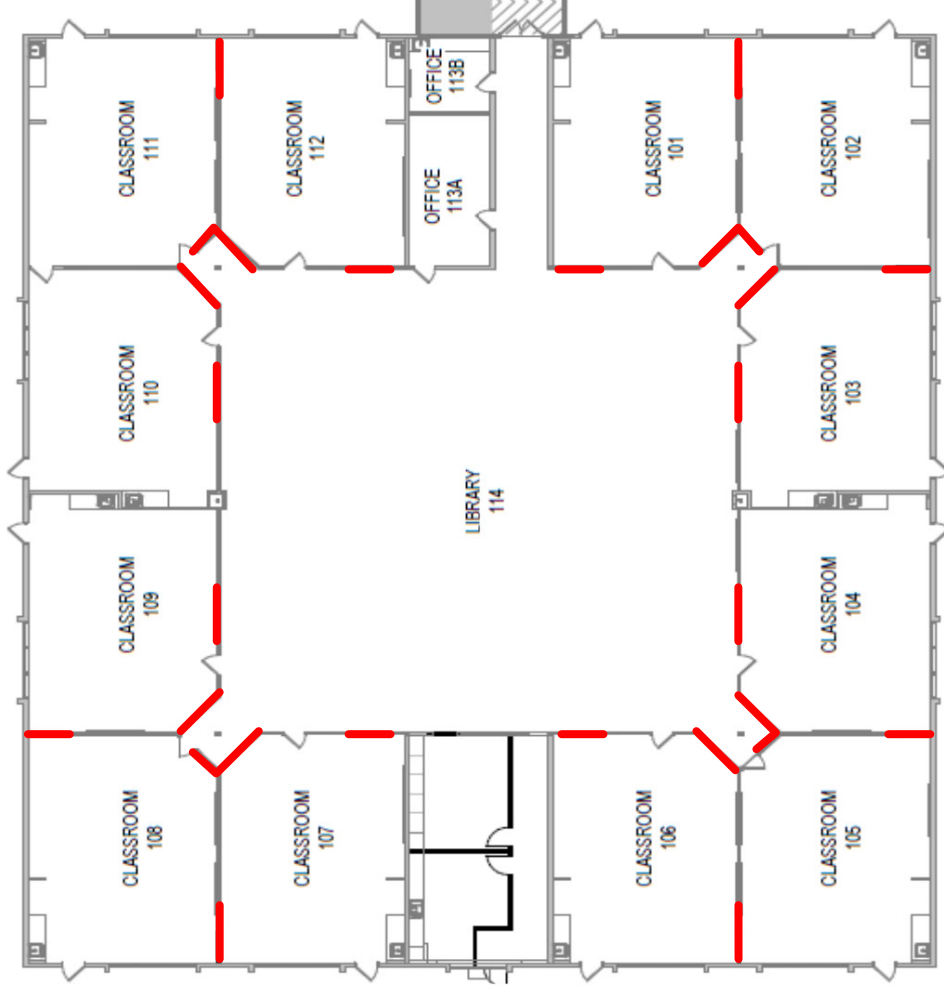
- A. The Asbestos Abatement Contractor's representative, in presence of Owner's consultant, shall inspect the entire work area for asbestos.
- B. If any suspect asbestos dust or debris is found, repeat final cleaning operation, until the visual inspection is satisfactory to the Owner's consultant.

- C. After final visual clearance criteria have been achieved in the work areas, the Owner's consultant will notify the Abatement Contractor to encapsulate all walls, floors, ceilings, other exposed surfaces, and decontamination facilities.
- D. Clearance air sampling will be completed by the Owner's consultant after the encapsulant has dried. Any costs associated with re-cleaning due to failed clearance results will be the sole responsibility of the Abatement Contractor. All clearance air samples shall be at or below 0.01 fibers per cubic centimeter as measured using Phase Contrast Microscopy (NIOSH 7400 method) or below 70 structures per square millimeter by Transmission Electron Microscopy (TEM) using the AHERA analytical method.
- E. After abatement clearance is given by the Asbestos Project Monitor the Abatement Contractor may remove the containment, which shall be disposed of as ACM.

3.07 WASTE DISPOSAL

- A. All waste will be transported and disposed of in compliance with DOT requirements and all applicable Federal, State and local regulations. Disposal must occur at an acceptable landfill accompanied by a waste manifest.
- B. A copy of all waste manifests shall be given to Owner upon completion of the project.

FIGURES



LEGEND

- Drywall, Joint Compound, White Wall Texture & Tan Wall Paper

ABATEMENT BID SPECIFICATION ASBESTOS ABATEMENT LOCATION DIAGRAM

KINNAMAN ELEMENTARY SCHOOL
4205 SW 193rd STREET
BEAVERTON, OREGON 97007

TRC Project No.: 515789

Drawn by: MC

Reviewed by: RAL

Figure: 1

Date: October 2022



4105 SE International Way, Suite 505
Milwaukie, Oregon 97222
Phone: (503) 387-3251 Fax: (503) 908-1318

APPENDIX A

**LIMITED ASBESTOS SURVEY REPORT
Kinnaman Elementary School
Pass Thru Project
4205 SW 193rd Avenue
Beaverton, Oregon 97078
Dated: December 12, 2018**

LIMITED ASBESTOS SURVEY REPORT

**Kinnaman Elementary School
Pass Thru Project
A108-A110 & A114-A116
4205 SW 193rd Ave
Beaverton, OR 97078**

Prepared for:

Beaverton School District
16650 SW Merlo Road
Beaverton, Oregon 97003

Report Date: December 12, 2018

Prepared By:



4105 SE International Way, Suite 505, Milwaukie, OR 97222

TRC Project: 321402

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Appendices

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EXECUTIVE SUMMARY

Beaverton School District contracted TRC Environmental Corporation (TRC) to conduct a limited scope asbestos survey for the Pass Thru Project at Kinnaman Elementary School located at 4205 SW 193rd Ave, Beaverton, OR. The survey activities were initiated on December 5, 2018, by Jason Stone and Chloe Hudson, Asbestos Hazard Emergency Response Act (AHERA) accredited Asbestos Building Inspectors.

Asbestos Containing Materials

Results of analysis confirmed asbestos was identified within some of the bulk samples collected. Asbestos-containing materials (ACM) are defined by the Occupational Safety and Health Administration (OSHA), the Environmental Protection Agency (EPA) and the State of Oregon Department of Environmental Quality (DEQ) as any material containing more than one percent (>1.0%) asbestos when analyzed using Polarized Light Microscopy (PLM) methods.

Material	Location	Percentage/ Type	Approx. Quantity	Condition	Material Type	NESHAP Category
Drywall & Joint Compound & White Texture & Tan Wallpaper	Rooms A108, A110, A114, & A116	D.W. = ND J.C. = 4% Chrysotile Texture = 5% Chrysotile W.P. = ND	4,800 SF	Good	Misc.	RACM

Any materials uncovered during renovation or demolition activities that are not addressed in this inspection report, or presumed asbestos containing materials (PACM), must be sampled by an accredited asbestos inspector prior to any disturbance, or they must be treated as asbestos containing (ACM).

INTRODUCTION

Beaverton School District contracted TRC Environmental Corporation (TRC) to conduct a limited scope asbestos survey for the Pass Thru Project at Kinnaman Elementary School located at 4205 SW 193rd Ave, Beaverton, OR. The survey activities were initiated on December 5, 2018, by Jason Stone and Chloe Hudson, Asbestos Hazard Emergency Response Act (AHERA) accredited Asbestos Building Inspectors.

BACKGROUND

Asbestos Containing Materials

Occupational Safety and Health Administration (OSHA) defines asbestos-containing material (ACM), as any material containing more than one percent asbestos.

The Environmental Protection Agency (EPA) defines ACM as follows:

1. Friable asbestos-containing material (ACM), is defined by the Asbestos NESHAP, as any material containing more than one percent (1%) asbestos as determined using the method specified in Appendix A, Subpart F, 40 CFR Part 763, Section 1, Polarized Light Microscopy (PLM), that, when dry, can be crumbled, pulverized or reduced to powder by hand pressure.
2. Nonfriable ACM is any material containing more than one percent (1%) asbestos as determined using the PLM method that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure. The EPA further defines two categories of nonfriable ACM:
 - a. Category I (Cat I) - Category I nonfriable ACM is any asbestos-containing packing, gasket, resilient floor covering or asphalt roofing product which contains more than one percent (1%) asbestos as determined using PLM according to the method specified in Appendix A, Subpart F, 40 CFR Part 763, and
 - b. Category II (Cat II) - Category II nonfriable ACM is any material, excluding Category I nonfriable ACM, containing more than one percent (1%) asbestos as determined using PLM according to the methods specified in Appendix A, Subpart F, 40 CFR Part 763 that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.
3. Regulated Asbestos-Containing Material (RACM) is (a) friable asbestos material, (b) Category I nonfriable ACM that has become friable, (c) Category I nonfriable ACM that will be or has been subjected to sanding, grinding, cutting or abrading, or (d) Category II nonfriable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations.

Asbestos Sampling Procedures

The survey was conducted in accordance with the sample collection protocols established in 40 CFR 763 (AHERA), 40 CFR 61 Subpart M (NESHAP). A summary of survey activities is provided below.

Survey activities began with visual observation of the project area to identify homogeneous areas of suspect ACM. A homogeneous area consists of building materials that appear similar throughout in terms of color and texture that does not extend to other buildings or floors. Visual assessments were conducted in accessible areas of the building. Building materials identified as glass, wood or metal were not considered suspect ACM.

A physical assessment of each homogeneous area of suspect ACM was conducted to assess the friability and condition of the materials. Friability was assessed by physically touching suspect materials.

Based on results of the visual observation, bulk samples of suspect ACM were collected in accordance with applicable Federal, State and local sampling protocols. Samples of suspect materials were collected in each homogeneous area. Bulk samples were collected using wet methods as applicable to reduce the potential for fiber release. Samples were placed in sealable containers and labeled with unique sample numbers using an indelible marker.

All asbestos bulk samples were submitted under proper COC documentation to the laboratory. Bulk samples were analyzed by PLM utilizing the EPA's, Method for the Determination of Asbestos in Bulk Building Materials, EPA 600/M4-82-020. Analysis by PLM was performed by visual observation of the bulk sample and slides prepared of the bulk sample for microscopic examination and identification. The samples were analyzed for asbestos (Chrysotile, Amosite, Crocidolite, Anthophyllite, and Actinolite/Tremolite), fibrous non-asbestos constituents (mineral wool, cellulose, etc.) and non-fibrous constituents. Using a stereoscope, the microscopist visually estimated the relative amounts of each constituent by determining the estimated area of the asbestos compared with the area estimate of the total sample.

Laboratory Analysis

Laboratory services were provided by EMC Labs, Inc., a National Voluntary Laboratory Accreditation Program (NVLAP) certified laboratory (NVLAP code #101926-0) located in Phoenix, Arizona.

FINDINGS

Asbestos Containing Materials

Laboratory analytical results indicated the following materials were positive for asbestos in concentrations greater than 1%:

Material	Location	Percentage/ Type	Approx. Quantity	Condition	Material Type	NESHAP Category
Drywall & Joint Compound & White Texture & Tan Wallpaper	Rooms A108, A110, A114, & A116	D.W. = ND J.C. = 4% Chrysotile Texture = 5% Chrysotile W.P. = ND	4,800 SF	Good	Misc.	RACM

Negative Materials (No Asbestos Detected)

Results of the bulk sampling indicated none of the following sampled materials contained detectable levels of asbestos, based on the PLM method:

Material Description	Material Location(s)	Estimated Quantity
Brick Grout	Rooms A108, A110, A114, and A116	960 SF
Cove Base & Glue	Rooms A108, A110, A114, and A116	120 LF
Carpet Glue	Rooms A108, A110, A114, and A116	800 SF
2'x4' Drop-in Ceiling Tile	Rooms A108, A110, A114, and A116	800 SF

RECOMMENDATIONS

Asbestos Containing Materials

Results of the bulk sampling indicated that one (1) of the five (5) materials sampled during this survey contained detectable levels of asbestos, based on the PLM method. These materials should be removed and disposed of by a licensed asbestos abatement contractor prior to conducting any renovation or demolition activities. Additionally, any materials uncovered during renovation/demolition activities that are not addressed in this inspection report, or assumed asbestos-containing material must be sampled by an accredited asbestos inspector prior to any disturbance, or they must be treated as asbestos containing.

DISCLAIMER

The content presented in this report is based on data collected during the site inspection and survey, review of pertinent regulations, requirements, guidelines and commonly followed industry standards, and information provided by Client, their clients, agents, and representatives.

The work has been conducted in an objective and unbiased manner and in accordance with generally accepted professional practice for this type of work. TRC believes the data and analysis to be accurate and relevant, but cannot accept responsibility for the accuracy or completeness of available documentation or possible withholding of information of other parties.

This limited asbestos survey report is designed to aid the property owner, architect, construction manager, general contractor, and asbestos abatement contractor in locating asbestos containing materials. This report is not intended to be utilized as a bidding document.

Sincerely,
TRC Environmental Corporation



Jason Stone
Project Manager



Ron Landolt, CAC
NW Region BSI Practice Manager

Appendix A – Sample Location Map



- Non-Asbestos Sample Location
- Asbestos-Containing Sample Location

ASBESTOS SURVEY REPORT SAMPLE LOCATION DIAGRAM

KINNAMAN ELEMENTARY SCHOOL
4205 SW 193rd STREET
BEAVERTON, OREGON 97007

TRC Project No.: 321402

Figure: 1

Drawn by: JS

Reviewed by: RAL

Date: 12/12/18



4105 SE International Way, Suite 505
Milwaukie, Oregon 97222

Phone: (503) 387-3251 Fax: (503) 908-1318

Appendix B – Laboratory Results and Chain of Custody

EMC LABS, INC.

9830 S. 51st Street, Suite B109, Phoenix, AZ 85044
Phone: 800-362-3373 or 480-940-5294 - Fax: (480) 893-1726

Laboratory Report

0212377

Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	TRC SOLUTIONS	Job# / P.O. #:	321402
Address:	4105 SE INTERNATIONAL WAY	Date Received:	12/07/2018
	STE 505	Date Analyzed:	12/07/2018
	MILWAUKIE OR 97222		
Collected:	12/05/2018	Date Reported:	12/07/2018
Project Name:	KINNAMAN ES	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212377-001 KES-01A	A116	Brick Grout, Gray/ Beige	No	None Detected	Quartz Gypsum Mica Carbonates Binder/Filler 100%
0212377-002 KES-01B	A114	Brick Grout, Gray/ Beige	No	None Detected	Quartz Gypsum Mica Carbonates Binder/Filler 100%
0212377-003 KES-01C	A108	LAYER 1 Brick, Orange/ Tan	No	None Detected	Quartz Gypsum Binder/Filler 100%
		LAYER 2 Brick Grout, Gray/ Beige	No	None Detected	Cellulose Fiber <1% Quartz Gypsum Mica Carbonates Binder/Filler 99%
0212377-004 KES-02A	A116	LAYER 1 Cove Base, Gray	No	None Detected	Carbonates Quartz Binder/Filler 100%
		LAYER 2 Mastic, Yellow	No	None Detected	Carbonates Quartz Gypsum Binder/Filler 100%

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Collected:	12/05/2018	Date Reported:	12/07/2018
Project Name:	KINNAMAN ES	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212377-005 KES-02B	A114	LAYER 1 Cove Base, Gray	No	None Detected	Carbonates Quartz Binder/Filler 100%
		LAYER 2 Mastic, Yellow	No	None Detected	Cellulose Fiber <1% Carbonates Quartz Gypsum Binder/Filler 99%
	A110	LAYER 1 Cove Base, Gray	No	None Detected	Carbonates Quartz Binder/Filler 100%
		LAYER 2 Mastic, Yellow	No	None Detected	Cellulose Fiber <1% Carbonates Quartz Gypsum Binder/Filler 99%
0212377-007 KES-03A	A116	Carpet Glue/ Leveling Compound, Brown/ Tan	No	None Detected	Cellulose Fiber 1%
					Carbonates Quartz Gypsum Binder/Filler 99%
0212377-008 KES-03B	A110	Carpet Glue/ Leveling Compound, Brown/ Tan/ Green	No	None Detected	Cellulose Fiber <1%
					Carbonates Quartz Gypsum Binder/Filler 99%

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Project Name:	KINNAMAN ES	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212377-009 KES-03C	A108	Carpet Glue/ Leveling Compound, Brown/ Tan/ Green	No	None Detected	Fibrous Glass <1% Carbonates Quartz Gypsum Binder/Filler 99%
0212377-010 KES-04A	A116	2x4 Ceiling Tile, Gray/ White/ Tan	No	None Detected	Cellulose Fiber 60% Mineral Wool 20% Carbonates Gypsum Quartz Perlite Binder/Filler 20%
0212377-011 KES-04B	A110	2x4 Ceiling Tile, Gray/ White/ Tan	No	None Detected	Cellulose Fiber 60% Mineral Wool 20% Carbonates Gypsum Quartz Perlite Binder/Filler 20%
0212377-012 KES-04C	A108	2x4 Ceiling Tile, Gray/ White/ Tan	No	None Detected	Cellulose Fiber 50% Mineral Wool 30% Carbonates Gypsum Quartz Perlite Binder/Filler 20%

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Project Name:	KINNAMAN ES	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212377-013 KES-05A	A116	LAYER 1 Drywall, White/ Brown/ Off White	No	None Detected	Cellulose Fiber 10% Fibrous Glass 2% Gypsum Mica Quartz Carbonates 88%
		LAYER 2 Joint Compound, White/ Off White	No	None Detected	Cellulose Fiber <1% Carbonates Mica Quartz Perlite Binder/Filler 99%
		LAYER 3 Tape, Cream	No	None Detected	Cellulose Fiber 98% Carbonates 2%
		LAYER 4 Texture/ Paint, White/ Off White/ Clear Note: Layer is mainly Paint - little Texture present	No	None Detected	Carbonates Mica Quartz Perlite Binder/Filler 100%

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Address:	4105 SE INTERNATIONAL WAY	Date Received:	12/07/2018
	STE 505	Date Analyzed:	12/07/2018
	MILWAUKIE OR 97222		
Collected:	12/05/2018	Date Reported:	12/07/2018
Project Name:	KINNAMAN ES	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212377-014 KES-05B	A114	LAYER 1 Drywall, White/ Brown/ Off White	No	None Detected	Cellulose Fiber 10% Fibrous Glass 2% Gypsum Mica Quartz Carbonates 88%
		LAYER 2 Joint Compound, White/ Off White	Yes	Chrysotile 5%	Carbonates Mica Quartz Binder/Filler 95%
		LAYER 3 Texture/ Wallpaper Mastic, White/ Off White/ Clear	Yes	Chrysotile 3%	Carbonates Mica Quartz Gypsum Binder/Filler 97%
		LAYER 4 Wallpaper, Tan/ Off White	No	None Detected	Cellulose Fiber 40% Carbonates Quartz Binder/Filler 60%

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NVLAP#101926-0

Client:	TRC SOLUTIONS	Job# / P.O. #:	321402
Address:	4105 SE INTERNATIONAL WAY	Date Received:	12/07/2018
	STE 505	Date Analyzed:	12/07/2018
	MILWAUKIE OR 97222		
Collected:	12/05/2018	Date Reported:	12/07/2018
Project Name:	KINNAMAN ES	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212377-015 KES-05C	A110	LAYER 1 Drywall, White/ Brown/ Off White	No	None Detected	Cellulose Fiber 10% Fibrous Glass 2% Gypsum Mica Quartz Carbonates 88%
		LAYER 2 Joint Compound, White/ Off White	Yes	Chrysotile 4%	Cellulose Fiber <1% Carbonates Mica Quartz Binder/Filler 95%
		LAYER 3 Texture/ Wallpaper Mastic, White/ Off White/ Clear	Yes	Chrysotile 3%	Carbonates Mica Quartz Gypsum Binder/Filler 97%
		LAYER 4 Wallpaper, Tan/ Off White	No	None Detected	Cellulose Fiber 40% Carbonates Quartz Binder/Filler 60%



Analyst - James A. Storm



Signatory - Lab Director - Kurt Kettler

Distinctly stratified, easily separable layers of samples are analyzed as subsamples of the whole and are reported separately for each discernible layer. All analyses are derived from calibrated visual estimate and measured in area percent unless otherwise noted. The report applies to the standards or procedures identified and to the sample(s) tested. The test results are not necessarily indicated or representative of the qualities of the lot from which the sample was taken or of apparently identical or similar products, nor do they represent an ongoing quality assurance program unless so noted. These reports are for the exclusive use of the addressed client and that they will not be reproduced wholly or in part for advertising or other purposes over our signature or in connection with our name without special written permission. The report shall not be reproduced except in full, without written approval by our laboratory. The samples not destroyed in testing are retained a maximum of thirty days. The laboratory measurement of uncertainty for the test method is approximately less than 1 by area percent. Accredited by the National Institute of Standards and Technology, Voluntary Laboratory Accreditation Program for selected test method for asbestos. The accreditation or any reports generated by this laboratory in no way constitutes or implies product certification, approval, or endorsement by the National Institute of Standards and Technology. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government. Polarized Light Microscopy may not be consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials.

CHAIN OF CUSTODY

EMC Labs, Inc.
9830 S. 51st St., Ste B-109
Phoenix, AZ 85044
(800) 362-3373 Fax (480) 893-1726

LAB#: 212377
TAT: Rush
Rec'd: DEC 07 AM

COMPANY NAME: TRC SOLUTIONS

BILL TO: (If Different Location)

4105 SE International Way, Suite 505

Phoenix, AZ

Milwaukie, Oregon 97222

CONTACT: Ron Landolt Scan & Excel

Phone/Fax: (503) 387-3251 / (503) 908-1318

Email: rlandolt@trcsolutions.com

Now Accepting: VISA - MASTERCARD

Price Quoted: \$ / Sample \$ / Layers

COMPLETE ITEMS 1-4: (Failure to complete any items may cause a delay in processing or analyzing your samples)**1. TURNAROUND TIME:** [4hr rush] [8hr rush] [1-Day] [2-Day] [3-Day] [5-Day] [6-10 Day]

****Prior confirmation of turnaround time is required

****Additional charges for rush analysis (please call marketing department for pricing details)

****Laboratory analysis may be subject to delay if credit terms are not met

2. TYPE OF ANALYSIS: [Bulk-PLM] [Air-PCM] [Lead] [Point Count] [Fungi: AOC, W-C, Bulk, Swab, Tape]**3. DISPOSAL INSTRUCTIONS:** [Dispose of samples at EMC] / [Return samples to me at my expense]

(If you do not indicate preference, EMC will dispose of samples 60 days from analysis.)

4. Project Name: Kinnaman ES

P.O. Number:

Project Number:

321402

EMC SAMPLE #	CLIENT SAMPLE #	DATE & TIME SAMPLED	LOCATION/MATERIAL TYPE	Samples Accepted Yes / No	AIR SAMPLE INFO / COMMENTS		
					ON	OFF	FLOW RATE
1	KES-01A	12/5/18	Brick Grout - A116	N			
2	KES-01B		↓ - A114	N			
3	KES-01C		↓ - A108	N			
4	KES-02A		Cove base + give - A116	N			
5	KES-02B		↓ - A114	N			
6	KES-02C		↓ - A110	N			
7	KES-03A		Carpet give - A116	N			
8	KES-03B		↓ - A110	N			
9	KES-03C		↓ - A108	N			
10	KES-04A		2x4 CT - A116	N			
11	KES-04B		↓ - A110	N			
12	KES-04C		↓ - A108	N			
13	KES-05A		Drywall + JC - A116	N			
14	KES-05B		↓ - A114	N			
15	KES-05C		↓ - A110	N			

SPECIAL INSTRUCTIONS:

Sample Collector: (Print) Jason Stone

(Signature)

Relinquished by: Jason Stone

Date/Time: 12/5/18

Received by: Diana Federico

Date/Time: 12/7/18

Relinquished by: Diana Federico

Date/Time: 12/7/18

Received by: [Signature]

Date/Time: 12/7/18

Relinquished by:

Date/Time:

Received by:

Date/Time:

** In the event of any dispute between the above parties for these services or otherwise, parties agree that jurisdiction and venue will be in Phoenix, Arizona and prevailing party will be entitled to attorney's fees and court costs.

Appendix C – Certifications

Certificate of Completion

This is to certify that

Jason Stone

has satisfactorily completed
4 hours of refresher training as an
AHERA Building Inspector

to comply with the training requirements of
TSCA Title II, 40 CFR 763 (AHERA)

164935

Certificate Number



Dec 18, 2017 Expires in 1 year.

Date(s) of Training

Exam Score:
if appropriate:

A handwritten signature in black ink, likely belonging to the instructor, written over a horizontal line.

Instructor

ARGUS PACIFIC, INC / 1900 WEST NICKERSON ST, SUITE 315 / SEATTLE, WASHINGTON 98119 / 206.285.3373 / ARGUSPACIFIC.COM

Certificate of Completion

This is to certify that

Chloe B. Hudson

has satisfactorily completed
24 hours of training as an

AHERA Building Inspector

to comply with the training requirements of
TSCA Title II, 40 CFR 763 (AHERA)

EPA Provider # 1085

167149

Certificate Number



A handwritten signature in blue ink, likely belonging to the instructor, written over a horizontal line.

Instructor

Apr 30 - May 2, 2018 Expires in 1 year.

Date(s) of Training

Exam Score: 88%
if appropriate:

ARGUS PACIFIC, INC / 1900 WEST NICKERSON ST, SUITE 315 / SEATTLE, WASHINGTON 98119 / 206.285.3373 / ARGUSPACIFIC.COM