



**WILKINSON ASSOCIATES INC**  
**CONSULTING ENGINEERS**

615 jefferson boulevard, warwick, rhode island 02886  
telephone (401) 737-6386 fax (401) 738-2167  
info @ wilkinsonassociates.net

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March 31, 2016

**PROJECT SPECIFICATIONS**

**Architectoral**  
**Mechanical**

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Project: #15055

**UNIT VENTILATOR REPLACEMENT**  
at the  
**EAST PROVIDENCE HIGH SCHOOL**

2000 Pawtucket Ave.  
East Providence, Rhode Island

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Prepared For:

The East Providence School Department  
35 Hoppin Avenue  
Riverside, Rhode Island

Ms Kathryn Crowley  
Superintendent

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*Note: Lab- Science door staying in place as  
noted on the CD.*

*G. Beach*  
*4/7/16*

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**SECTION 01 1000  
SUMMARY**

**PART 1 GENERAL**

**1.01 PROJECT**

- A. Project Name: Renovations to EPHS Science Wing Unit Ventilator Replacement
- B. Owner's Name: City of East Providence.
- C. Engineer's Name: Wilkinson Associates Inc
- D. Architect's Name: Ed Wojcik Architect, Ltd. .
- E. The Project consists of the renovation of 9 science classrooms, including demolition and new installation of ventilator units and casework, and associated equipment and accessories. Work to include renovations to HVAC, Electrical. The work is expected to be accomplished during the Summer months of 2015.
- F. The General Contractor shall secure all permits for the work. All permit fees have been waived for this project, with the exception of the ADA fee, which must be paid by the General Contractor.

**1.02 DESCRIPTION OF ALTERATIONS WORK**

- A. Scope of demolition and removal work is shown on drawings and specified in Section 02 4100.
- B. Scope of alterations work is shown on drawings.
- C. HVAC: Alter existing system and add new construction, keeping existing in operation.
- D. Electrical Power and Lighting: Alter existing system and add new construction, keeping existing in operation.

**1.03 OWNER OCCUPANCY**

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

**1.04 CONTRACTOR USE OF SITE AND PREMISES**

- A. Construction Operations: Limited to areas noted on Drawings.
- 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 WORK SEQUENCE**

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 01 3000**  
**ADMINISTRATIVE REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Submittals for review, information, and project closeout.
- B. Number of copies of submittals.
- C. Submittal procedures.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 SUBMITTALS FOR REVIEW**

- A. When the following are specified in individual sections, submit them for review:
  - 1. Product data.
  - 2. Shop drawings.
  - 3. Samples for selection.
  - 4. Samples for verification.
- B. Submit to Architect/Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed only for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

**3.02 SUBMITTALS FOR INFORMATION**

- A. When the following are specified in individual sections, submit them for information:
  - 1. Design data.
  - 2. Certificates.
  - 3. Test reports.
  - 4. Inspection reports.
  - 5. Manufacturer's instructions.
  - 6. Manufacturer's field reports.
  - 7. Other types indicated.
- B. Submit for Engineer/Architect's knowledge as contract administrator or for Owner. No action will be taken.

**3.03 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:
  - 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.

**3.04 NUMBER OF COPIES OF SUBMITTALS**

- A. Documents for Review:
  - 1. Small Size Sheets, Not Larger Than 8-1/2 x 11 inches: Submit the number of copies that Contractor requires, plus two copies that will be retained by Architect.

- B. Documents for Information: Submit two copies.
- C. 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.

### 3.05 SUBMITTAL PROCEDURES

- A. Shop Drawing Procedures:
  - 1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related Work.
  - 2. Do not reproduce the Contract Documents to create shop drawings.
  - 3. Generic, non-project specific information submitted as shop drawings do not meet the requirements for shop drawings.
- B. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
- C. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
- D. **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.**
- E. Deliver submittals to Architect at business address.
- F. Schedule submittals to expedite the Project, and coordinate submission of related items.
- G. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
- H. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
- I. Provide space for Contractor and Architect review stamps.
- J. When revised for resubmission, identify all changes made since previous submission.
- K. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- L. Submittals not requested will not be recognized or processed.

**END OF SECTION**

**SECTION 01 4000  
QUALITY REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. References and standards.
- B. Control of installation.
- C. Control of installation.
- D. Defect Assessment.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 CONTROL OF INSTALLATION**

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

**3.02 DEFECT ASSESSMENT**

- A. Replace Work or portions of the Work not conforming to specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

**END OF SECTION**

**SECTION 01 5000**  
**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. Waste removal facilities and services.

**1.02 TEMPORARY UTILITIES**

- A. Owner will provide the following:
  - 1. Electrical power , consisting of connection to existing facilities.
  - 2. Water supply, consisting of connection to existing facilities.
- B. Use trigger-operated nozzles for water hoses, to avoid waste of water.

**1.03 TEMPORARY SANITARY FACILITIES**

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.
- C. At end of construction, return facilities to same or better condition as originally found.

**1.04 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. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

**1.05 VEHICULAR ACCESS AND PARKING - SEE SECTION 01 5500**

- 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.

**1.06 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.

**1.07 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS**

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing facilities used during construction to original condition.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 01 6000  
PRODUCT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. General product requirements.
- B. Sustainable design-related product requirements.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations and procedures.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.

**1.02 RELATED REQUIREMENTS**

- A. Document 00 2113 - Instructions to Bidders: Product options and substitution procedures prior to bid date.
- B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

**1.03 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 the Contract Documents.
- B. DO NOT USE products having any of the following characteristics:
  - 1. Made using or containing CFC's or HCFC's.
  - 2. Made of wood from newly cut old growth timber.
- C. Where all other criteria are met, Contractor shall give preference to products that:
  - 1. If used on interior, have lower emissions, as defined in Section 01 6116.
  - 2. If wet-applied, have lower VOC content, as defined in Section 01 6116.
  - 3. Have a published GreenScreen Chemical Hazard Analysis.
- D. Products with Rapidly Renewable Material Content:
  - 1. Definition: Materials made from plants that are typically harvested within 10 years or less after planting.
  - 2. Specific Product Categories: Provide renewable material content as specified elsewhere.
  - 3. Calculations: Where information about renewable material content is required to be submitted and an item is not made completely of rapidly renewable material, calculate content by dividing the renewable material content by weight by the total weight of the item.

## 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.

## 2.03 MAINTENANCE MATERIALS

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

## PART 3 EXECUTION

### 3.01 SUBSTITUTION PROCEDURES

- A. Instructions to Bidders specifies time restrictions for submitting requests for substitutions during the bidding period and the documents required. Comply with requirements specified in Section 00 2113.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- C. A request for substitution 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.
  - 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.
- D. Substitution Submittal Procedure (after contract award):
  - 1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
  - 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
  - 3. The Architect will notify Contractor in writing of decision to accept or reject request.

### 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.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- H. Comply with manufacturer's warranty conditions, if any.
- I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- J. Prevent contact with material that may cause corrosion, discoloration, or staining.
- K. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- L. 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**

**SECTION 01 7000**  
**EXECUTION AND CLOSEOUT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Cleaning and protection.
- F. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 1000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
- B. Section 01 3000 - Administrative Requirements: Submittals procedures.
- C. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.
- D. Section 07 8400 - Firestopping.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
  - 1. Structural integrity of any element of Project.
  - 2. Integrity of weather exposed or moisture resistant element.
  - 3. Efficiency, maintenance, or safety of any operational element.
  - 4. Visual qualities of sight exposed elements.
  - 5. Work of Owner or separate Contractor.

**1.04 QUALIFICATIONS**

- A. For demolition work, employ a firm specializing in the type of work required.
  - 1. Minimum of 5 years of documented experience.

**1.05 PROJECT CONDITIONS**

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.

**1.06 COORDINATION**

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

## **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 6000 - 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 PREINSTALLATION MEETINGS**

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Engineer/Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
  - 1. Review conditions of examination, preparation and installation procedures.
  - 2. Review coordination with related work.

- E. Record minutes and distribute copies within two days after meeting to participants, with pdf copies to Architect, Owner, participants, and those affected by decisions made.

### 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 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 shown.
  - 2. Report discrepancies to Engineer/Architect before disturbing existing installation.
  - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Remove existing work as indicated and as required to accomplish new work.
  - 1. Remove items indicated on drawings.
  - 2. Relocate items indicated on drawings.
  - 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
  - 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- C. Services (Including but not limited to HVAC, Plumbing, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
  - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
  - 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
  - 3. 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.
    - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
    - b. Provide temporary connections as required to maintain existing systems in service.
  - 4. Verify that abandoned services serve only abandoned facilities.
  - 5. 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; patch holes left by removal using materials specified for new construction.
- 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.
- E. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
- F. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

- G. Clean existing systems and equipment.
- H. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- I. Do not begin new construction in alterations areas before demolition is complete.
- J. Comply with all other applicable requirements of this section.

### 3.06 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. 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-conforming work.
- D. 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.
- E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.
- J. 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.

### 3.07 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.

### 3.08 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 plastic coverings if possible.

### **3.09 ADJUSTING**

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

### **3.10 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,
- 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. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

### **3.11 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**

**SECTION 01 7800  
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 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Section 01 7000 - 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. Operation and Maintenance Data:
  - 1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
  - 2. 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.
  - 3. Submit two sets of revised final documents in final form within 10 days after final inspection.
- B. 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 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 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.

**3.02 OPERATION AND MAINTENANCE DATA**

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

**3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES**

- A. For Each Product, Applied Material, and Finish:
- 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.

**3.04 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**

**SECTION 02 4100  
DEMOLITION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Selective demolition of building elements for alteration purposes.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 1000 - Summary: Sequencing and staging requirements.
- C. Section 01 1000 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- D. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- E. Section 01 6000 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- F. Section 01 7000 - 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 2 PRODUCTS -- NOT USED**

**PART 3 EXECUTION**

**3.01 SCOPE**

- A. Remove portions of existing buildings as follows:
  - 1. unit ventilators.
  - 2. Steel unit shelving.
  - 3. Remove as indicated on drawings.
- B. Remove underground tanks that contain or once contained petroleum products; fill and bury other types of tanks.
- C. Remove air conditioning units indicated, for salvage and relocation.

**3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS**

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
  - 1. Obtain required permits.
  - 2. 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.
- 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.

**3.03 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 shown.
  - 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. 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.

**3.04 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**

**SECTION 06 1000  
ROUGH CARPENTRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Preservative treated wood materials.
- B. Miscellaneous framing and sheathing.
- C. Concealed wood blocking, nailers, and supports.

**PART 2 PRODUCTS**

**2.01 GENERAL REQUIREMENTS**

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
  - 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
  - 2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee ([www.alsc.org](http://www.alsc.org)) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old growth timber is not permitted.

**2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS**

- A. Grading Agency: Western Wood Products Association (WWPA).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- 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 per ASTM A 153/A 153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

**2.04 FACTORY WOOD TREATMENT**

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
  - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
  - 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Preservative Treatment:
  - 1. Preservative Pressure Treatment of Lumber Above Grade: AWWA U1, Use Category UC3B, Commodity Specification A using waterborne preservative to 0.25 lb/cu ft retention.
    - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
    - b. Treat lumber in contact with masonry or concrete.

**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.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

**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 framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- C. 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.
- D. Provide the following specific non-structural 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.

**END OF SECTION**

**SECTION 06 2000  
FINISH CARPENTRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Finish carpentry items.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 06 4100 - Architectural Wood Casework: Shop fabricated custom cabinet work.

**1.03 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- C. PS 1 - Structural Plywood; 2009.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Protect work from moisture damage.

**PART 2 PRODUCTS**

**2.01 FINISH CARPENTRY ITEMS**

- A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI (AWS) for Custom Grade.

**2.02 WOOD-BASED COMPONENTS**

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

**2.03 LUMBER MATERIALS**

- A. Softwood Lumber: poplar species, plain sawn, maximum moisture content of 6 percent; with flat grain, of quality suitable for transparent finish.
- B. Hardwood Lumber: oak species, plain sawn, maximum moisture content of 6 percent; with flat grain, of quality suitable for transparent finish.

**2.04 SHEET MATERIALS**

- A. Softwood Plywood Exposed to View: Face species as indicated, plain sawn, medium density fiberboard core; PS 1 Grade A-B; glue type as recommended for application.

**2.05 ACCESSORIES**

- A. Wood Filler: Solvent base, tinted to match surface finish color.

**2.06 WOOD TREATMENT**

- A. Fire Retardant Treatment (FR-S Type): Chemically treated and pressure impregnated; capable of providing flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
- B. Provide identification on fire retardant treated material.
- C. Redry wood after pressure treatment to maximum \_\_\_\_ percent moisture content.

**2.07 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 work in accordance with AWI/AWMAC/WI (AWS) 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. Do not use additional overlay trim to conceal larger gaps.

**3.03 TOLERANCES**

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

**END OF SECTION**

**SECTION 07 8400  
FIRESTOPPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 7000 - Execution and Closeout Requirements: Cutting and patching.
- B. Section 09 2116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

**1.03 REFERENCE STANDARDS**

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2015.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.
- C. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- D. FM 4991 - Approval Standard for Firestop Contractors; Factory Mutual Research Corporation; 2013.
- E. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- F. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; [www.aqmd.gov](http://www.aqmd.gov).
- G. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- C. Sustainable Design Submittal: Submit VOC content documentation for all non-preformed materials.

**1.05 QUALITY ASSURANCE**

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
  - 1. Listing in the current-year classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.
  - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at [www.icc-es.org](http://www.icc-es.org) will be considered as constituting an acceptable test report.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
  - 1. Approved by Factory Mutual Research Corporation under FM 4991.

**1.06 FIELD CONDITIONS**

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

**PART 2 PRODUCTS**

**2.01 FIRESTOPPING - GENERAL REQUIREMENTS**

- A. Manufacturers:

1. A/D Fire Protection Systems Inc: [www.adfire.com](http://www.adfire.com).
  2. 3M Fire Protection Products: [www.3m.com/firestop](http://www.3m.com/firestop).
  3. Hilti, Inc: [www.us.hilti.com](http://www.us.hilti.com).
  4. Nelson FireStop Products: [www.nelsonfirestop.com](http://www.nelsonfirestop.com).
  5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Firestopping: Any material meeting requirements.
- C. Firestopping Materials with Volatile Content: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
- D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

## **2.02 FIRESTOPPING SYSTEMS**

- A. Firestopping: Any material meeting requirements.
1. Fire Ratings: Use any system that is listed by UL (FRD), FM P7825, or ITS (DIR) and tested in accordance with ASTM E814 or ASTM E119 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify openings are ready to receive the work of this section.

### **3.02 PREPARATION**

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

### **3.03 INSTALLATION**

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authority having jurisdiction.

### **3.04 CLEANING**

- A. Clean adjacent surfaces of firestopping materials.

### **3.05 PROTECTION**

- A. Protect adjacent surfaces from damage by material installation.

**END OF SECTION**

**SECTION 07 9005  
JOINT SEALERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Sealants and joint backing.
- B. Precompressed foam sealers.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping: Firestopping sealants.
- B. Section 09 2116 - Gypsum Board Assemblies: Acoustic sealant.

**1.03 REFERENCE STANDARDS**

- A. ASTM C834 - Standard Specification for Latex Sealants; 2014.
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- E. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; [www.aqmd.gov](http://www.aqmd.gov).

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the work with other sections referencing this section.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics.

**1.06 FIELD CONDITIONS**

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

**PART 2 PRODUCTS**

**2.01 SEALANTS**

- A. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
- B. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
  - 1. Color: Match adjacent finished surfaces.
  - 2. Applications: Use for:
    - a. Interior wall and ceiling control joints.
    - b. Joints between door and window frames and wall surfaces.
    - c. Other interior joints for which no other type of sealant is indicated.
- C. Acoustical Sealant for Concealed Locations:
  - 1. Composition: Acrylic latex emulsion sealant.
  - 2. Applications: Use for concealed locations only:
    - a. Sealant bead between top stud runner and structure and between bottom stud track and floor.

**2.02 ACCESSORIES**

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

- C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

**3.02 PREPARATION**

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

**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 where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- G. Tool joints concave.

**3.04 CLEANING**

- A. Clean adjacent soiled surfaces.

**END OF SECTION**

**SECTION 09 6500  
RESILIENT FLOORING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Resilient tile flooring.
- B. Resilient base.
- C. Installation accessories.

**1.02 REFERENCE STANDARDS**

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- C. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2014)e1.
- D. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012)e1.
- E. NECHPS - Northeast Collaborative of High Performing Schools; MP1: Specifying Low Emission Materials; current edition
- F. GEI (SCH) - GREENGUARD "Children and Schools" Certified Products; GREENGUARD Environmental Institute; current listings at [www.greenguard.org](http://www.greenguard.org).
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; National Fire Protection Association; 2015.
- H. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.
- I. SCS (CPD) - SCS Certified Products; Scientific Certification Systems; current listings at [www.scs-certified.com](http://www.scs-certified.com).

**1.03 SUBMITTALS**

- A. See Section 01 3000 - 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. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. **Extra Flooring Material:** 450 square feet of VCT color #1, 135 square feet of color #2, and 90 square feet of color #3
- F. **Certification: Submit documentation certifying compliance with NECHPS, MP1 Prerequisite.**

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Protect roll materials from damage by storing on end.

**1.05 FIELD CONDITIONS**

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

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

## **PART 2 PRODUCTS**

### **2.01 TILE FLOORING**

- A. **Vinyl Composition Tile (Base Bid):** Homogeneous, with color extending throughout thickness, and:
1. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
  2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
  3. Size: 12 by 12 inch.
  4. VOC Content: Certified as Low Emission by one of the following :
    - a. GreenGuard Children and Schools; [www.greenguard.org](http://www.greenguard.org).
    - b. SCS Floorscore; [www.scs-certified.com](http://www.scs-certified.com).
  5. Thickness: 0.125 inch.
  6. Pattern: TO MATCH EXISTING.
  7. Manufacturers:
    - a. Armstrong World Industries, Inc; \_\_\_\_\_: [www.armstrong.com](http://www.armstrong.com).
    - b. Johnsonite, a Tarkett Company; \_\_\_\_\_: [www.johnsonite.com](http://www.johnsonite.com).
    - c. Mannington Mills, Inc; \_\_\_\_\_: [www.mannington.com](http://www.mannington.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.

B.

### **2.02 RESILIENT BASE**

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
1. Height: 4 inch.
  2. Thickness: 0.125 inch thick.
  3. Finish: Satin.
  4. Length: Roll.
  5. Color: TO MATCH EXISTING.
  6. Manufacturers:
    - a. Burke Flooring; \_\_\_\_\_: [www.burkemercer.com](http://www.burkemercer.com).
    - b. Johnsonite, a Tarkett Company; \_\_\_\_\_: [www.johnsonite.com](http://www.johnsonite.com).
    - c. Roppe Corp; \_\_\_\_\_: [www.roppe.com](http://www.roppe.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.

### **2.03 ACCESSORIES**

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Moldings, Transition and Edge Strips: Same material as flooring.
- C. Sealer and Wax: Types recommended by flooring manufacturer.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
1. Test in accordance with ASTM F710.

2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

### **3.02 PREPARATION**

- A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings.
- B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- C. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- D. Prohibit traffic until filler is cured.

### **3.03 INSTALLATION**

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints tightly.
- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

### **3.04 TILE FLOORING**

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless manufacturer's instructions say otherwise.
- B. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.

### **3.05 RESILIENT BASE**

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.

### **3.06 CLEANING**

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's instructions.
- C. Provide sealer and wax as recommended by manufacturer and per schools maintenance procedures.

**END OF SECTION**

**SECTION 09 9000  
PAINTING AND COATING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 DEFINITIONS**

- A. Conform to ASTM D16 for interpretation of terms used in this section.

**1.03 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.
- D. GreenSeal GS-11 - Paints and Coatings; 2013.
- E. USGBC LEED-NC - LEED Green Building Rating System for New Construction and Major Renovations; U.S. Green Building Council; 2009.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
  - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
  - 2. MPI product number (e.g. MPI #47).
  - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
  - 1. Where sheen is specified, submit samples in only that sheen.
- D. Certification: By manufacturer that all paints and coatings do not contain any of the prohibited chemicals specified; GreenSeal GS-11 certification is not required but if provided shall constitute acceptable certification.
- E. 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 coated surfaces, and color samples of each color and finish used.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

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

#### 1.06 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
  - 1. Base Manufacturer: Sherwin Williams.
- C. Stains:
  - 1. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
- D. Block Fillers: Same manufacturer as top coats.
- E. Substitutions: See Section 01 6000 - Product Requirements.

#### 2.02 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
  - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  - 2. Supply each coating material in quantity required to complete entire project's work from a single production run.
  - 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content:
  - 1. Provide coatings 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. Architectural coatings VOC limits of the State in which the Project is located.
  - 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.

- D. Colors: To be selected from manufacturer's full range of available colors.
  - 1. Selection to be made by Architect after award of contract.
  - 2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.

### 2.03 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - All Interior Surfaces Indicated to be Painted, Unless Otherwise Indicated: Including gypsum board, plaster, and shop primed steel.
  - 1. Two top coats and one coat primer.
  - 2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143-148.
  - 3. Eggshell: MPI gloss level 3; use this sheen at gypsum walls.
  - 4. Semi-Gloss: MPI gloss level 5; use this sheen at door frames.
  - 5. Primer(s): As recommended by manufacturer of top coats.
- B. Paint MI-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
  - 1. Touch-up with latex primer.
  - 2. Semi-gloss: Two coats of latex enamel; at door frames.
- C. Paint GI-OP-3L - Gypsum Board/Plaster, Latex, 3 Coat:
  - 1. One coat of alkyd primer sealer.
  - 2. Eggshell: Two coats of latex enamel; at walls.
- D. Paint GI-OP-3LA - Gypsum Board/Plaster, Latex-Acrylic, 3 Coat:
  - 1. One coat of alkyd primer sealer.
  - 2. Eggshell: Two coats of latex-acrylic enamel; at textured walls.

### 2.04 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
  - 1. Gypsum Wallboard: 12 percent.
  - 2. Plaster and Stucco: 12 percent.
  - 3. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
  - 4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

### 3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating 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. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

- F. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Plaster Surfaces to be Painted: 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. Shop-Primed Steel Surfaces to be Finish Painted: 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.
- J. Interior Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

### 3.03 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- 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.
- D. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

### 3.04 CLEANING

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

### 3.05 PROTECTION

- A. Protect finished coatings until completion of project.
- B. Touch-up damaged coatings after Substantial Completion.

**END OF SECTION**

**SECTION 23 90 00 – HVAC: CONTROL SYSTEM DIGITAL**

**PART 1 - GENERAL**

**RELATED DOCUMENTS:**

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00      MECHANICAL GENERAL REQUIREMENTS

Refer to and coordinate all work with the work of the following listed Sections:

Section 23 00 50      MECHANICAL: ELECTRICAL COMPONENTS

Section 23 54 50      HVAC: STEAM SYSTEMS

Section 23 85 00      HVAC: EQUIPMENT

Section 23 90 00      HVAC; CONTROL SYSTEM DIGITAL

Section 23 94 00      HVAC: CONTROL SEQUENCE OF OPERATIONS

Section 23 95 00      HVAC: TESTING AND BALANCING

**SCOPE:**

Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.

The system equipment manufacturer shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems with open communications capabilities as herein specified.

The control system and components provided shall be capable of full integration into the facilities existing Tritium Niagara based control network.

**RELATED WORK:**

Work in conjunction with this section shall be as designated below:

General Contractor:

Cutting, Patching, and Painting  
Openings in floors and walls  
Equipment foundations and bases

The demarcation of work and responsibilities between the BMS Contractor and other related trades shall be as outlined in the following BMS RESPONSIBILITY MATRIX:

<b>BMS RESPONSIBILITY MATRIX</b>				
<b>WORK</b>	<b>FURNISH</b>	<b>INSTALL</b>	<b>Low Volt. WIRING/TUBE</b>	<b>LINE POWER</b>
BMS low voltage and communication wiring	BMS	BMS	BMS	N/A
Line voltage and power wiring	Div 26	Div 26	N/A	Div 26
BMS conduits and raceway	BMS	BMS	BMS	BMS
Automatic dampers	BMS	Div 23	N/A	N/A
Manual valves	Div 23	Div 23	N/A	N/A
Automatic valves	BMS	Div 23	BMS	N/A
BMS Current Switches.	BMS	BMS	BMS	N/A
BMS Control Relays	BMS	BMS	BMS	N/A
Power distribution system monitoring interfaces	Div 26	Div 26	BMS	Div 26
BMS interface with Classroom Unit Ventilator Controls	BMS	BMS	BMS	Div 26
Classroom Unit Ventilator Controls Interface with BMS	Div 23	Div 23	BMS	Div 26
Connect to existing KMC control valves.	Div 23	Div 23	BMS	Div 26
Control damper actuators	BMS	BMS	BMS	Div 26
Demand control ventilation CO2 monitoring.	BMS	BMS	BMS	Div 26

\*Line voltage wiring required for the automatic control system not indicated on the electrical drawings shall be furnished and installed by the BMS system contractor in accordance with the requirements of Division 26.

**WIRING:**

The mechanical/temperature controls contractor(s) shall provide all wiring, relays, transformers, devices, etc. necessary (regardless of voltage) for automatic controls.

Wiring provided by Mechanical Contractor(s) shall be in accordance with the National Electric Code, local and state codes and Division 26. Wiring shall be in conduit, regardless of voltage, unless noted otherwise.

**QUALITY ASSURANCE:**

The control system shall be designed and installed, commissioned and serviced by manufacturer trained personnel. The BMS Contractor shall have a branch facility within a 100-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis.

Control contractor shall be a manufacturer authorized system installer.

The manufacturer shall provide full time, on site, experienced project manager for this work, responsible for direct supervision of the design, installation, start up and commissioning of the control system.

The control contractor shall be regularly engaged in the manufacturing, installation and maintenance of digital control systems and shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the manufacture, installation and maintenance of control systems similar in size and complexity to this project. A maintained service organization consisting of at least ten (10) competent servicemen for a period of not less than ten years and provide a list of 10 projects, similar in size and scope to this project, completed within the last five years.

Installation: None but competent technicians, regularly employed in the control trade, shall install the system.

Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.

#### PROJECT ADMINISTRATION:

Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.

Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

#### SUBMITTALS:

See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00 .

Shop drawings shall be prepared (see Section 23 00 00) and submitted for approval within the time period stated: (This listing is not intended to all inclusive – provide submittals for all materials and equipment proposed for use on this project)

The BMS contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.

Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.

Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.

Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.

The BMS Contractor shall correct any errors or omissions noted in the first review.

At a minimum, submit the following:

BMS network architecture diagrams including all nodes and interconnections.

Systems schematics, sequences and flow diagrams.

Points schedule for each point in the BMS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.

Samples of Graphic Display screen types and associated menus.

Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.

Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.

Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.

Room Schedule including a separate line for each Unit Ventilator indicating location.

Details of all BMS interfaces and connections to the work of other trades.

Product data sheets or marked catalog pages including part number, photo and description for all products including software.

#### PROJECT CLOSEOUT:

Review and provide closeout requirements of this section and Section 15000 Mechanical General Requirements, including:

- Testing and Adjusting
- Record Drawings
- Operating, Maintenance Instructions
- Written Guarantee
- Lubrication, Filters
- Operating, Maintenance Manuals
- Cleaning
- Test Log
- Letters of compliance.

#### WARRANTY:

Provide all services, materials and equipment necessary for the successful operation of the entire control system for a period of one year after beneficial use.

The adjustment, required testing, and repair of the system includes all computer equipment, transmission equipment and all sensors and control devices.

The on-line support services shall allow the local control subcontractor to dial out over telephone lines to monitor and control the facility's building automation system. This remote connection to the facility shall be within 2 hours of the time that the problem is reported. This coverage shall be extended to include normal business hours, after business hours, weekends and holidays.

If the problem cannot be resolved on-line by the local office, the national office of the building automation system manufacturer shall have the same capabilities for remote connection to the facility. If the problem cannot be resolved with on-line support services, the controls manufacturer shall dispatch the appropriate personnel to the job site to resolve the problem within 4 hours of the time that the problem is reported.

#### OPERATION AND MAINTENANCE MANUALS:

Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the BMS provided:

Table of contents.

As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.

Manufacturers product data sheets or catalog pages for all products including software.

System Operator's manuals.

Archive copy of all site-specific databases and sequences.

BMS network diagrams.

Interfaces to all third-party products and work by other trades.

The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

## **PART 2 - PRODUCTS**

### GENERAL DESCRIPTION:

The work required involves the modification of the facilities existing building management system as required to allow interface with the replacement chiller.

The replacement chiller will be furnished complete with an on-board factory controller with BAC Net interface.

New components provided to allow interface with the existing Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.

The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

The System shall maintain all settings and overrides through a system reboot.

System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.

#### ACCEPTABLE MANUFACTURERS

KMC per the Building Standard.

#### DDC SYSTEM CONTROLLERS:

Existing Equipment to be Salvaged for Re-Use:

Provide all labor and material required to remove the existing digital system controllers and related sensors from the existing classroom unit ventilators for re-use in the new classroom unit ventilator systems.

The existing controllers shall be stored in a safe, dust free location pending their re-installation.

#### Field Equipment Controller (FEC)

The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.

The FEC shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

The FEC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

The FEC shall be tested and certified as a BACnet Application Specific Controller (B-ASC).

A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.

The Conformance Statement shall be submitted 10 days prior to bidding.

The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.

Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable. The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

The FEC shall include troubleshooting LED indicators to identify the following conditions:

Power On

Power Off

Download or Startup in progress, not ready for normal operation

No Faults

Device Fault

Field Controller Bus - Normal Data Transmission

Field Controller Bus - No Data Transmission

Field Controller Bus - No Communication

Sensor-Actuator Bus - Normal Data Transmission

Sensor-Actuator Bus - No Data Transmission

Sensor-Actuator Bus - No Communication

The FEC shall accommodate the direct wiring of analog and binary I/O field points.

The FEC shall support the following types of inputs and outputs:

Universal Inputs - shall be configured to monitor any of the following:

- Analog Input, Voltage Mode
- Analog Input, Current Mode
- Analog Input, Resistive Mode
- Binary Input, Dry Contact Maintained Mode
- Binary Input, Pulse Counter Mode

Binary Inputs - shall be configured to monitor either of the following:

- Dry Contact Maintained Mode
- Pulse Counter Mode

Analog Outputs - shall be configured to output either of the following:

- Analog Output, Voltage Mode
- Analog Output, current Mode

Binary Outputs - shall output the following:

- 24 VAC Triac

Configurable Outputs - shall be capable of the following:

- Analog Output, Voltage Mode
- Binary Output Mode

The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).

The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.

The FC Bus shall support communications between the FECs and the NAE.

The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the NAE.

The FC Bus shall support a minimum of 100 IOMs and FECs in any combination.

The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.

The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).

The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard Protocol SSPC-135, Clause 9.

The SA Bus shall support a minimum of 10 devices per trunk.

The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.

The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.

The FEC shall support, but not be limited to, the following applications:

- Heating central plant applications
- Built-up air handling units for special applications
- Terminal & package units
- Special programs as required for systems control

#### FIELD DEVICES:

##### Input/Output Module (IOM):

The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.

The IOM shall communicate with the FEC over the FC Bus or the SA Bus.

The IOM shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

The IOM shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

The IOM shall be tested and certified as a BACnet Application Specific Controller (B-ASC).

A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.

The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

The IOM shall have a minimum of 4 points to a maximum of 17 points.

The IOM shall support the following types of inputs and outputs:

Universal Inputs - shall be configured to monitor any of the following:

- Analog Input, Voltage Mode
- Analog Input, Current Mode
- Analog Input, Resistive Mode
- Binary Input, Dry Contact Maintained Mode
- Binary Input, Pulse Counter Mode

Binary Inputs - shall be configured to monitor either of the following:

- Dry Contact Maintained Mode
- Pulse Counter Mode

Analog Outputs - shall be configured to output either of the following:

- Analog Output, Voltage Mode
- Analog Output, current Mode

Binary Outputs - shall output the following:

- 24 VAC Triac

Configurable Outputs - shall be capable of the following:

- Analog Output, Voltage Mode
- Binary Output Mode

The IOM shall include troubleshooting LED indicators to identify the following conditions:

- Power On
- Power Off
- Download or Startup in progress, not ready for normal operation
- No Faults
- Device Fault
- Normal Data Transmission
- No Data Transmission
- No Communication

#### INPUT DEVICES:

General Requirements:

Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

Temperature Sensors, General:

Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.

The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.

The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
1) Room Temp	2) $\pm .5^{\circ}\text{F}$ .
3) ECM Motor	4) $\pm .5 \text{ VA}$
5) CO2	6) $\pm 0.5 \text{ PPM}$

#### Temperature Sensing Thermo Wells:

When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.

Thermo wells shall be pressure rated and constructed in accordance with the system working pressure. Thermo wells and sensors shall be mounted in a threadolet or 1/2" NPT saddle and allow easy access to the sensor for repair or replacement.

Thermo wells shall be constructed of 316 stainless steel.

#### Differential Pressure Transmitters; General Requirements:

Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.

Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.

Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.

A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.

#### Status and Safety Switches:

##### General Requirements:

Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

OUTPUT DEVICES:

Control Pilot Relays:

Control pilot relays shall be of a modular plug-in design with retaining springs or clips.

Mounting Bases shall be snap-mount.

DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.

Contacts shall be rated for 10 amps at 120VAC.

Relays shall have an integral indicator light and check button.

Acceptable manufacturers: Lectro

Electronic Signal Isolation Transducers:

A signal isolation transducer shall be provided whenever an analog output signal from the BMS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input signal from a remote system.

The signal isolation transducer shall provide ground plane isolation between systems.

Signals shall provide optical isolation between systems.

Acceptable manufacturers: Advanced Control Technologies

MISCELLANEOUS DEVICES:

Local Control Panels:

All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.

In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.

All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.

All wiring shall be neatly installed in plastic trays or tie-wrapped.

A 120 volt convenience outlet, fused on/off power switch, and required transformers shall be provided in each enclosure.

### PART 3 - EXECUTION

#### PROJECT MANAGEMENT:

Provide a designated project manager who will be responsible for the following:

- Construct and maintain project schedule
- On-site coordination with all applicable trades, subcontractors, and other integration vendors
- Authorized to accept and execute orders or instructions from owner/architect
- Attend project meetings as necessary to avoid conflicts and delays
- Make necessary field decisions relating to this scope of work
- Coordination/Single point of contact

#### ELECTRIC WIRING AND MATERIALS:

##### BMS Wiring:

All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.

Provide all electric wiring and connections required for the control system.

The control system shall be installed by skilled electricians who are properly trained and qualified for this work.

Supervision and checkout of the system shall be by local branch engineers directly employed by the ATC contractor.

All electric wiring and wiring connections, including line voltage power wiring, required for the installation of the temperature control system, as herein specified, shall be provided by the temperature control contractor unless specifically shown on the electrical drawings or called for in the electrical specifications.

All necessary power wiring that is not indicated on the electrical drawings, for the control system shall be provided by the Control System Contractor. All final power connections to the control system will be performed by the Control System contractor. Designated circuit breakers shall be furnished by the electrical contractor in the distribution panelboards for this purpose.

All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.

The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.

##### Class 2 Wiring:

All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.

Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers

designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.

Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.

Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

**BMS Line Voltage Power Source:**

120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers provided by Division 16.

Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes. DDC terminal unit controllers may use AC power from motor power circuits.

**BMS Raceway:**

All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".

Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.

All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.

Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

**Penetrations:**

Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.

All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.

All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

**BMS Identification Standards:**

Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.

Cable types specified in Item A shall be color coded for easy identification and troubleshooting.  
**BMS Panel Installation**

The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.

The BMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

**INPUT DEVICES:**

All Input devices shall be installed per the manufacturer recommendation.

Locate components of the BMS in accessible local control panels wherever possible.

**HVAC INPUT DEVICES:**

General:

All Input devices shall be installed per the manufacturer recommendation.

Locate components of the BMS in accessible local control panels wherever possible.

The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.

Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.

**HVAC OUTPUT DEVICES:**

General:

All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.

Electronic Signal Isolation Transducers:

Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

**EXISTING CONTROL DEVICES TO REMAIN IN SERVICE:**

The bid for the control work shall be based on the premise that existing control devices are operational and are not in need of repair or replacement, unless otherwise noted.

This subcontractor shall notify the owner's representative of existing control devices that need to be replaced or repaired that may be noted in the process of installation of the new work.

#### START-UP AND COMMISSIONING:

##### General:

When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on-line. All testing, calibrating, adjusting and final field tests shall be completed by the manufacturer. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power.

Provide any recommendation for system modification in writing to owner. Do not make any system modification, including operating parameters and control settings, without prior approval of owner.

The BMS Contractor shall issue a report based on a sampling of the performance metrics of the system's various control loops. The report shall indicate performance criteria, include the count of conforming and non-conforming system elements, list the non-conforming elements along with performance data.

After manufacturer has completed system start-up and commissioning. Joint commissioning of integrated system segments shall be completed.

#### PERFORMANCE VERIFICATION TESTING (PVT) / START-UP AND COMMISSIONING:

##### General:

When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on-line. All testing, calibrating, adjusting and final field tests shall be completed by the Temperature Control Contractor. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power.

Provide any recommendation for system modification in writing to owner. Do not make any system modification, including operating parameters and control settings, without prior approval of owner.

After manufacturer has completed system start-up and commissioning. Joint commissioning of integrated system segments shall be completed.

##### Performance Verification Testing (PVT):

The PVT shall demonstrate compliance of the control system work with the contract requirements. The PVT shall be performed by the Contractor and witnessed and approved by the Owner. A Pre-PVT meeting to review the Pre-PVT Checklist is required to coordinate all aspects of the PVT and shall include the Contractor's QA representative, the Contractor's PVT administrator, the Contracting Officer's representative.

Upon successful completion of the PVT, submit a PVT Report to the Government and prior to the Government taking use and possession of the facility. Do not submit the report until all problems are corrected and successfully re-tested. The report shall include the annotated PVT Plan used during the PVT. Where problems were identified, explain each problem and the corrective action taken. Include a written certification that the installation and testing of the control system is complete and meets all of the contract's requirements.

##### Performance Verification Testing Plan:

Submit a detailed PVT Plan of the proposed testing for Owner approval. Develop the PVT Plan specifically for the control system in this contract. The PVT Plan shall be an clear list of test items

arranged in a logical sequence. Include the intended test procedure, the expected response, and the pass/fail criteria for every component tested.

The plan shall clearly describe how each item is tested, indicate where assisting personnel are required (like the mechanical contractor), and include what procedures are used to simulate conditions. Include a separate column for each checked item and extra space for comments. Where sequences of operations are checked, insert each corresponding routine from the project's sequence of operation. For each test area, include signature and date lines for the Contractor's PVT administrator, the Contractor's QA representative, the Contracting Officer's representative to acknowledge successful completion.

#### PVT Sample Size:

Test all central plant equipment and primary air handling unit controllers unless otherwise directed. Twenty percent sample testing is allowed for identical controllers typical of terminal control systems, (i.e. fan coil units, VAV Boxes, finned tube radiation, unit heaters, chilled beams).

The owner may require testing of like controllers beyond a statistical sample if sample controllers require retesting or do not have consistent results.

The Owner may witness all testing, or random samples of PVT items. When only random samples are witnessed, the Owner may choose which ones.

#### Pre-Performance Verification Testing Checklist:

Submit the following as a list with items checked off once verified. Provide a detailed explanation for any items that are not completed or verified.

Verify all required mechanical installation work is successfully completed, and all HVAC equipment is working correctly (or will be by the time the PVT is conducted).

- Verify HVAC motors operate below full-load amperage ratings.
- Verify all required control system components, wiring, and accessories are installed.
- Verify the installed control system architecture matches approved drawings.
- Verify all control circuits operate at the proper voltage and are free from grounds or faults.
- Verify all required surge protection is installed.
- Verify all DDC network communications function properly, including uploading and downloading programming changes.
- Using the BACnet protocol analyzer (if provided or required in this specification), verify communications are error free.
- Verify each digital controller's programming is backed up.
- Verify all wiring, components, and panels are properly labeled.
- Verify all required points are programmed into devices.
- Verify all TAB work affecting controls is complete.
- Verify all valve and actuator zero and span adjustments are set properly.
- Verify all sensor readings are accurate and calibrated.
- Verify each control valve and actuator goes to normal position upon loss of power.
- Verify all control loops are tuned for smooth and stable operation. View trend data where applicable.
- Verify each controller works properly in stand-alone mode.
- Verify all safety controls and devices function properly, including freeze protection and interfaces with building fire alarm systems.
- Verify all electrical interlocks work properly.

- Verify all workstations, notebooks and maintenance personnel interface tools are delivered, all system and database software is installed, and graphic pages are created for each workstation and notebook.
- Verify the as-built (shop) control drawings are completed.

#### Conducting Performance Verification Testing:

Conduct Owner-witnessed PVT after approval of the PVT Plan and the completed Pre-PVT Checklist. Notify the Contracting Officer of the planned PVT at least 15 days prior to testing. Provide an estimated time table required to perform the testing. Furnish personnel, equipment, instrumentation, and supplies necessary to perform all aspects of the PVT.

Ensure that testing personnel are regularly employed in the testing and calibration of DDC systems.

Using the project's as-built control system (shop) drawings, the project's mechanical design drawings, the approved Pre-PVT Checklist, and the approved PVT Plan, conduct the PVT.

During testing, identify any items that do not meet the contract requirements and if time permits, conduct immediate repairs and re-test. Otherwise, deficiencies shall be investigated, corrected, and re-tested later. Document each deficiency and corrective action taken.

If re-testing is required, follow the procedures for the initial PVT. The Owner may require re-testing of any control system components affected by the original failed test.

#### Controller Capability and Labeling:

Test the following for each controller:

- Memory: Demonstrate that programmed data, parameters, and trend/ alarm history collected during normal operation is not lost during power failure.
- Direct Connect Interface: Demonstrate the ability to connect directly to each type of digital controller with a portable electronic device like a notebook computer or PDA. Show that maintenance personnel interface tools perform as specified in the manufacturer's technical literature.
- Stand Alone Ability: Demonstrate controllers provide stable and reliable stand-alone operation using default values or other method for values normally read over the network.
- Wiring and AC Power: Demonstrate the ability to disconnect any controller safely from its power source using the AC Power Table. Demonstrate the ability to match wiring labels easily with the control drawings. Demonstrate the ability to locate a controller's location using the BACnet Communication Architecture Schematic and floor plans.

#### Nameplates and Tags:

Show the nameplates and tags are accurate and permanently attached to control panel doors, devices, sensors, and actuators.

#### Workstation and Software Operation:

At existing University frontend:

- Show points lists agree with naming conventions.
- Show that graphics are complete.
- Show the UPS operates as specified.

BACnet Communications and Interoperability Areas:

Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. If available or required in this specification, use a BACnet protocol analyzer to assist with identifying devices, viewing network traffic, and verifying interoperability. These requirements must be met even if there is only one manufacturer of equipment installed. Testing includes the following:

- Data Presentation: On each BACnet Operator Workstation, demonstrate graphic display capabilities.
- Reading of Any Property: Demonstrate the ability to read and display any used readable object property of any device on the network.
- Set point and Parameter Modifications: Show the ability to modify all set points and tuning parameters in the sequence of control or listed on project schedules. Modifications are made with BACnet messages and write services initiated by an operator using workstation graphics, or by completing a field in a menu with instructional text.
- Peer-to-Peer Data Exchange: Show all BACnet devices are installed and configured to perform BACnet read/write services directly (without the need for operator or workstation intervention), to implement the project sequence of operation, and to share global data.
- Alarm and Event Management: Show that alarms/events are installed and prioritized according to the FMCS Owner. Demonstrate time delays and other logic is set up to avoid nuisance tripping, e.g., no status alarms during unoccupied times or high supply air during cold morning start-up. Show that operators with sufficient privilege can read and write alarm/event parameters for all standard BACnet event types. Show that operators with sufficient privilege can change routing (BACnet notification classes) for each alarm/event including the destination, priority, day of week, time of day, and the type of transition involved (TO-OFF NORMAL, TO-NORMAL, etc.).
- Schedule Lists: Show that schedules are configured for start/stop, mode change, occupant overrides, and night setback as defined in the sequence of operations.
- Schedule Display and Modification: Show the ability to display any schedule with start and stop times for the calendar year. Show that all calendar entries and schedules are modifiable from any connected workstation by an operator with sufficient privilege.
- Archival Storage of Data: Show that data archiving is handled by the operator workstation/server, and local trend archiving and display is accomplished with BACnet Trend Log objects.
- Modification of Trend Log Object Parameters: Show that an operator with sufficient privilege can change the logged data points, sampling rate, and trend duration.
- Device and Network Management: Show the following capabilities

- Display of Device Status Information
- Display of BACnet Object Information
- Silencing Devices that are Transmitting Erroneous Data
- Time Synchronization
- Remote Device Re-initialization
- Backup & Restore Device Programming and Master Database(s)
- Configuration Management of Half-Routers, Routers and BBMDs

TRAINING:

One day of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

The BMS Contractor shall provide all students with a student binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 am to 4:30 PM weekdays.

Provide 8 hours of training for Owner's designated operating personnel. Training shall include:

- Explanation of drawings, operations and maintenance manuals
- Walk-through of the job to locate control components
- Operator workstation and peripherals
- DDC controller and ASC operation/function
- Operator control functions including graphic generation and field panel programming
- Operation of portable operator's terminal
- Explanation of adjustment, calibration and replacement procedures
- Student binder with training modules

Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Manufacturer. If such training is required by the Owner, it will be contracted at a later date.

**PART 3 - TEMPERATURE, SYSTEM OPERATION STATUS, AND ALARM POINTS:**

General:

The following is a general listing of control points that are required for this project. Additional control points may be required and shall be provided as required to allow the specified sequence of systems operations to be achieved. Refer to Specification Section 23 90 00 – HVAC Control Sequence of Operations for additional information.

Temperature Status Analog Input Points:

- Outdoor Air Drybulb Temperature

Demand Control Ventilation:

- CO2 Sensor PPM

Digital Status Input Points:

- Unit Ventilator Operation
- Unit Ventilator Trouble
- Unit Ventilator Airflow

Digital Output Points:

- Unit Ventilator On/Off

Alarm Points:

- Unit Ventilator Trouble
- Coil Freeze Protection

**END OF SECTION 23 90 00**

**SECTION 15940 – HVAC CONTROL SEQUENCE OF OPERATION**

**PART 1 - GENERAL**

RELATED DOCUMENTS:

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 and the following listed sections as a minimum, apply fully to work in this section.

Section 230000	MECHANICAL GENERAL REQUIREMENTS
Section 230050	MECHANICAL: ELECTRICAL COMPONENTS
Section 239000	HVAC: CONTROL SYSTEM / DIGITAL

Refer to and coordinate all work with the work of the following listed Sections:

Section 235450	HVAC: STEAM SYSTEMS
Section 238500	HVAC: EQUIPMENT
Section 239500	HVAC: TESTING AND BALANCING

INTENT:

The intention of these Specifications and Drawings is to call for finished work, debugged, tested and ready for operation.

Equipment and / or materials specified in the singular shall be provided in quantities as required for complete systems.

GENERAL OPERATIONS

Control sequences are generally worded for direct acting type of control. Controls shall be direct or reverse acting to match the fail position of the actuator or device.

Label function of all control panel alarms switches, indicators, and manual control devices. Label units of analog indicators.

STAGED RESTART

The building electrical service shall be monitored by the digital control system, via a current transducer monitor. In the event of a power failure, restart of all HVAC equipment shall be staged by the digital control system at 30 second intervals (interval time setpoint variable).

Restart of equipment shall be in selected order, provide listing for approved order determination.

## PART 2 - SEQUENCE OF OPERATIONS

### GENERAL DESCRIPTION:

Provide a complete control system with an energy conserving sequence of operations to control the heating, and ventilation systems as indicated for this project.

### OCCUPIED / UNOCCUPIED CONTROL:

The HVAC systems shall be sequenced to operate in either the "Occupied", or "Unoccupied" mode of operation through the digital control system.

At each occurrence of changeover from "unoccupied" to "occupied" the digital control system shall start the equipment in the order as specified under AUTOMATIC STAGED RESTART.

### LOW TEMPERATURE PROTECTION:

All Unit Ventilators with steam coils and fresh air connections shall be provided with Low Temperature Protection.

A temperature sensing element, located at the discharge face of the heating coil, shall stop the unit supply and associated exhaust fans, fully close the outdoor air inlet damper, fully close the associated relief and exhaust damper and fully open the return air damper.

For units with valve control: valve shall open fully to the coil.

For units with face and bypass control: dampers shall position to bypass.

An alarm shall occur at the digital control system.

### FIRE ALARM SHUT DOWN:

In the event of fire alarm in any area of the facility the Digital Automatic Control System shall shut down the operation of all air handling equipment. The fire alarm signal will be provided by others.

After the alarm signal has cleared, all air handling shall be automatically restarted as specified under AUTOMATIC STAGED RESTART.

### CLASSROOM TYPE UNIT VENTILATOR CONTROL: STEAM COIL

#### Heating, Occupied:

The blower at the unit shall run continuously, with the outdoor air damper open to its pre-set minimum position.

Whenever the outdoor air temperature is less than 40 deg F, (setpoint variable), the steam control valve at the coil shall be positioned to the fully open position. The face and bypass dampers shall modulate via a signal from the DCP as required to maintain the desired space temperature, (72 F, setpoint variable.)

Whenever the outdoor air temperature is above 40 deg F, (setpoint variable), The face and bypass dampers shall cycle to the "full face" position. The 2-way control valve at the coil shall modulate via a signal from the DCP as required to maintain the desired space temperature, (72 F, setpoint variable.)

In the event that the space temperature should continue to rise above set point, with the control valve in the fully closed position and the face and bypass dampers in the full coil bypass position, the economizer cooling cycle shall be enabled.

**Demand Control Ventilation:**

The unit's ECM motor and the outdoor and return air dampers shall modulate airflow as required to satisfy the space Carbon Dioxide sensor.

A low level discharge air temperature controller shall be provided to modulate the fresh air and return air dampers to prevent a discharge temperature less than 55 ° F, (set point variable).

**Heating, Unoccupied:**

The outdoor air damper shall be in its fully closed position and the steam control valve shall position to allow full flow through the coil.

Should the space temperature fall below set point, the blower at the unit shall cycle as required to maintain the desired "Unoccupied" temperature (62° F, set point variable).

**Economizer Cooling:**

During the "Occupied" mode of operation, the economizer cycle shall be enabled when the space temperature continues to rise above set point with the control valve in the fully closed position and the face and bypass dampers in the full coil bypass position; and the outdoor air temperature is at a level lower than the space temperature.

The outdoor air and return air dampers shall modulate as required to maintain the desired space temperature, (72 F, setpoint variable.)

A low level discharge air temperature controller shall be provided to modulate the fresh air and return air dampers to prevent a discharge temperature less than 55 ° F, (set point variable).

**END OF SECTION 239400**

**SECTION 239500 – HVAC TESTING ADJUSTING BALANCING**

**PART 1 - GENERAL**

RELATED DOCUMENTS:

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 and the following listed sections as a minimum, apply fully to work in this section.

Section 230000           MECHANICAL GENERAL REQUIREMENTS

Refer to and coordinate all work with the work of the following listed Sections:

Section 235450           HVAC: STEAM SYSTEMS

Section 238500           HVAC: EQUIPMENT

Section 239000           HVAC: CONTROL SYSTEM / DIGITAL

Section 239400           HVAC: CONTROL SEQUENCE OF OPERATIONS

SCOPE:

Provide for an independent balancing concern to provide labor, equipment and materials to complete the Balancing Adjusting Testing of the heating, ventilating and air conditioning system including temperature controls, and interrelated equipment indicated.

This Section specifies the requirements and procedures for testing, adjusting, and balancing air and water distribution systems. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and recording and reporting the results.

Testing, adjusting and balancing is the process of checking and adjusting mechanical system parameters to produce the design objectives. It includes:

Balancing of air distribution systems

Balancing of steam distribution systems

Recording temperature entering and leaving all coils (Steam and Air)

Adjustment of the total systems to provide the design quantities.

Electrical measurement.

Verification of performance of all equipment and automatic controls.

RELATED WORK:

Work in conjunction with this section shall be as designated below:

General Contractor:	Access to all equipment Coordination.
HVAC Contractor:	Provide coordination and data on equipment furnished.

PROJECT ADMINISTRATION:

Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Owner / Engineer.

NOTIFICATION / COORDINATION:

The balancing concern shall *notify the Engineer at all times when balancing is to be performed*. The general contractor and the HVAC contractor shall insure that all systems are ready for balancing/final adjustment prior to notification of the balancing concern to proceed.

Systems shall be fully operational prior to beginning testing, adjusting, and balancing procedures.

SUBMITTALS REQUIRED:

Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.

Engineer and Technician Data: Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.

Procedures and Agenda: Submit a synopsis of the testing, adjusting, and balancing procedures and agenda proposed to be used for this project.

Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this data in the maintenance manual.

Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems.

SCHEDULE OF SUBMISSIONS:

Balancing Report Prior to substantial completion. 3 Copies.

QUALITY ASSURANCE:

Agency Qualifications:

Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting results.

The independent testing, adjusting, and balancing agency shall be certified by NEEB, TAB and/or SMACNA in those disciplines required for this Project.

Codes and Standards:

NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".

ASHRAE: ASHRAE Handbook, 1987 Systems Volume, Chapter 57; Testing, Adjusting, and Balancing.

BALANCING CONCERN:

Selection of the Subcontractor for this work shall be subject to the Owner's approval.

Select from the following:

Leonhardt Company, 27 Harvard Street, Brookline, MA  
Arden Engineering Service Group, 435 Narragansett Park Dr. Pawtucket, RI.  
Thomas-Young Associates, Inc., P.O. Box 567, Marion, MA 02738 (508 748 0204)  
Kyle Baker Associates, Poccasett Ave, Providence

DEFINITIONS:

Adjust: To regulate the specified fluid flow rate at the terminal equipment.

Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.

Branch: Pipe serving a single terminal.

Branch main: Pipe serving two or more terminals.

Main: Pipe containing the system's major or entire fluid flow.

Procedure: Standardized approach and execution of a sequence of work operations to yield reproducible results.

Report Forms: Test data sheets arranged for collecting test data in logical order for submission and review. These forms should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

Submain: Pipe containing part of the system's capacity and serving two or more branch mains.

Terminal: The point where the controlled fluid enters or leaves the distribution system.

Test: To determine the quantitative performance of equipment.

**COSTS:**

Carry the amount proposed from anyone of the listed firms as a part of the base bid. Indicate with the bid which of the listed firms is included within the base bid.

**PART 2 – BALANCING / FINAL ADJUSTMENT**

**GENERAL:**

Test, adjust and balance the systems provided to achieve design operation and to set and mark all adjustable equipment for economical operation.

Obtain design drawings and specifications for the project and become thoroughly acquainted with the design intent.

**PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING:**

Before operating the system, perform the following steps:

Walk the system from the steam and condensate distribution piping to terminal units to determine variations of installation from design.

Check filters for cleanliness.

Check dampers for correct and locked position, and temperature controls for completeness.

Prepare report test sheets for both fans and outlets. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.

Place outlet dampers in the full open position.

Prepare schematic drawing of system ductwork and piping layouts to facilitate reporting.

Lubricate all motors and bearings.

Check fans for proper direction of rotation.

**SYSTEM TESTS, GENERAL:**

Scope: Subsequent to final Testing Adjusting and balancing, all control systems shall be adjusted and calibrated such that performance of all equipment is operating as intended.

**MEASUREMENTS, INSTRUMENTS AND SUPPLIES:**

Provide all required instrumentation to obtain proper measurements. Instruments shall meet the requirements specified in the referenced standards, and shall be calibrated to the tolerances specified therein. Instruments shall be properly maintained and protected against damage.

Use only those instruments that have the maximum field measuring accuracy and are best suited to the measurement being made.

Apply each instrument as recommended by the manufacturer.

Use instruments with the maximum number of scale subdivisions and with the minimum scale range for the value being measured.

When averaging values, take a sufficient number of readings to give a repeatability error of less than 5%. When measuring a single point, repeat readings until two consecutive identical readings are obtained.

Take all readings with the eye at the level of the indicated value to prevent parallax.

Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuating readings.

Take measurements at locations that will render the most accurate data.

#### AIR FLOW BALANCE; GENERAL:

Scope: After the completion of the air distribution systems, adjust and balance the systems to deliver air quantities as indicated or as directed.

Perform testing, adjusting, and balancing procedures on each system identified in accordance with the detailed procedures outlined in the referenced standards.

#### Preliminary Procedures:

Adjust and balance flows to specified design quantities with a tolerance of +/- 5%.

Adjust and balance supply and return airflows for systems.

Mark equipment settings of controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

Instruments: Calibrate and maintain all instruments used in checking, balancing the system. Perform accuracy tests on instruments whenever requested by Owner, Engineer, or Architect.

Air Measurement: Measure air quantities in main ducts by pitot tube traverse of the entire cross section area of the duct. Openings in ducts for tests shall be sealed with snap-in plugs after tests. Outlet and inlet air quantities shall be determined by direct reading velocity meters.

Air Quantity Adjustments: Total air quantities shall be obtained by adjusting fan speed.

Fresh air intake: Test and set all intake dampers, fans, or other devices to be tight closing when off and to allow stated amounts of fresh air intake during operation. Note all amounts of leakage CFM and operating CFM.

Air System Data:

Fans:	Design RPM Final RPM	Design CFM Final CFM	Design Static Pressure Actual Static Pressure (suction - discharge)
Fan Motor:	Full Load Amps Operating Amps		
Air system:	Outside air minimum - maximum at economizer cycle. Cooling Coil: air temperature entering-leaving.		

APPARATUS TEST REPORT: Provides details of actual measured flow rates, motor loads and other information that will be useful to compare design to actual system component performance.

PERFORMING TESTING, ADJUSTING, AND BALANCING:

Perform testing, adjusting, and balancing procedures on each system identified in accordance with the detailed procedures outlined in the referenced standards.

Adjust and balance airflows to specified design quantities with a tolerance of  $-3\%$  to  $+7\%$  of total flowrate.

Adjust and balance steam flows as follows.

Steam coils:	Capacity as stated in schedule on the drawing
Valves:	Mark and set all reminder stops for proper balance.

**PART 3 - REPORT**

GENERAL:

The balancing concern shall record and submit for evaluation and review three copies of a complete Balancing Report.

Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by, the referenced standards.

Prepare a report of recommendations for correcting unsatisfactory mechanical performance when system cannot be successfully balanced or performance tested.

REPORT FORMAT:

Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced.

In addition to the Report Forms, the Testing Adjusting and balancing results shall also be noted on reproducible drawings of the building provided by the Owner / Engineer for that purpose. All data as specified herein shall be neatly and accurately indicated.

**REPORT CONTENTS:**

Identification of testing, adjusting, and balancing agency, Owner, and Project. Include addresses, contact names, and telephone numbers. The seal and name, address, telephone number, and signature of the Test and Balance Engineer.

A listing of the instruments used for the procedures, and proof that all instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

The appropriate forms containing, as a minimum, the information indicated on the standard report forms prepared by the Associated Air Balance Council (AABC) and the National Environmental Balancing Bureau (NEBB) for each respective item and system. Prepare an accompanying schematic diagram that includes each item of equipment in the system being tested.

**END OF SECTION 239500**

**DIVISION 15 - MECHANICAL**

**SECTION 23 00 00 - MECHANICAL GENERAL REQUIREMENTS**

**PART 1 - GENERAL**

**RELATED DOCUMENTS:**

Drawings, provisions of the Contract, and Division 01 Specification Sections, apply fully to work in this section.

All requirements of this Section shall govern the work under all of the Sections of Division 23 - Mechanical including:

Section 23 00 40	MECHANICAL: DEMOLITION
Section 23 00 50	MECHANICAL: ELECTRICAL COMPONENTS
Section 23 01 50	MECHANICAL: VIBRATION ISOLATION
Section 23 02 50	MECHANICAL: PIPE HANGERS AND SUPPORTS
Section 23 03 00	MECHANICAL: FIRE SAFING / FIRESTOPPING
Section 23 04 00	MECHANICAL: INSULATION
Section 23 04 40	MECHANICAL: PIPE CLEANING TESTING
Section 23 54 50	HVAC: STEAM SYSTEMS
Section 23 85 00	HVAC: EQUIPMENT
Section 23 90 00	HVAC: CONTROL SYSTEM / DIGITAL
Section 23 94 00	HVAC: CONTROL SEQUENCE OF OPERATIONS
Section 23 95 00	HVAC: TESTING ADJUSTING BALANCING

**DEFINITIONS:**

The term "Mechanical" applies and refers to all work specified within Division 23 and as indicated on the Contract Drawings.

The term "Mechanical Contractor(s)" applies and refers to all those furnishing labor and materials for the completion of the work specified within Division 23 and as indicated on the Contract Drawings. All subcontractors and sub-subcontractors, as defined within the General Conditions, are collectively termed "Mechanical Contractor(s)". The requirements of Section 23 00 00 apply to all Mechanical Contractor(s).

The term "this Section" shall mean "this Section of the Specifications". The term "this Division" shall refer to "Division 23 - Mechanical" and all of its Sections.

Wherever the word "provide" is used, it shall mean "furnish and install complete and ready for use".

"Concealed" shall mean hidden from sight in trenches, chases, furred spaces, shafts, above hung ceilings, embedded in construction, in attic spaces or in crawl spaces.

"Work by others" shall mean "not by Mechanical Contractor but provided or installed by the General Contractor or any other sub-contractor performing their respective work within this contract".

**INTENT:**

The intention of these Specifications and Drawings is to call for finished work, tested and ready for operation.

The drawings are diagrammatic and not intended to show every pipe, offset, associated equipment or other minor detail. Provide such parts, materials, and appliances as required to complete the systems for operation.

Equipment and/or materials specified in the singular shall be provided in quantities as required for complete systems.

**EXISTING CONDITIONS:**

Prior to submitting a bid, visit the site, become familiar with the existing conditions, with the contract work of all trades, and become fully knowledgeable of how it relates to this Division.

**PROJECT MEETINGS:**

Provide knowledgeable personnel to attend meetings scheduled (Include all trades) as required.

**COORDINATION / COOPERATION:**

Cooperate with all other tradesmen, Contractors and Subcontractors to facilitate the completion of the work as a whole, as indicated on the drawings and specifications.

Wherever work interconnects with the work of other Contractors, coordinate the work with these Contractors to insure that all information is available such that all equipment and material may be installed properly with all necessary connections and appurtenances.

Coordinate the location of all openings required for apparatus and transmit this information sufficiently in advance, so that all openings in walls, slabs, roofs, piping supports, inserts and equipment including sleeves and access doors may be properly installed.

Where work will be installed in close proximity to, or interfere with the work of other trades, assist in coordinating space conditions to a satisfactory adjustment. If directed by the Architect/Engineer, provide composite working drawings indicating the proposed adjustment.

All distribution systems which require pitch or slope such as plumbing drains, sprinkler piping, and condensate drain piping shall have the right of way over those systems which do not require pitch. Where the work to be installed is located by detail and or elevation, that work shall have the right of way over items indicated as schematic or without indicated location (electrical conduits, control conduits etc). Confer, coordinate and cooperate with other trades as to the location of pipes, lights, and apparatus and install all work to avoid conflict and interference.

Work that is installed to interfere with the work of others prior to proper coordination and cooperation, shall be adjusted to correct the situation without extra compensation.

**DELAYS:**

Become fully informed as to availability dates of materials and equipment to be provided. Where availability dates interfere with the progress of the work or the Sequence of Operations, notify the Architect/Engineer and transmit all recommendations, including any changes in costs, to remedy the situation.

Final decisions as to the procedure in cases of delays, strikes, and acts of God shall be in writing by the Architect/Engineer. **DO NOT alter work, materials or equipment without written authority by the Architect/Engineer.**

Order equipment and materials in advance of the time of installation to avoid project delays.

**WORKMANSHIP:**

Workmanship shall be of the highest quality, in the best practice of the trade, and none but competent mechanics skilled in their respective trades shall be employed. Materials and apparatus shall be provided, delivered, erected, connected, and finished in every detail; and shall be so selected and arranged as to fit properly into building spaces.

**DRAWINGS:**

Refer to all Contract Drawings for a full comprehension of the extent and detail of the work. Drawings are supplementary to the specification and work indicated, mentioned or implied in either is considered as specified by both.

Work indicated on the drawings is intended to be approximately correct to scale, but dimensions and details are to assume precedence.

Typical details apply to every like item. They are not repeated in full on all of the drawings, which are diagrammatic only, but with the intention that such typical details are fully applicable.

**INTERPRETATION OF PLANS AND SPECIFICATIONS:**

The Architect/Engineer, whose interpretation shall be final, conclusive and binding on all parties, shall decide questions or disagreements as to the true intent of this specification and drawings.

**CODES, ORDINANCES, AGENCIES:**

The State Building Code, Fire Code and local ordinances, with all amendments to date, are hereby made a part of these specifications. Work shall conform to State Codes and Regulations.

The codes and ordinances shall be considered as a minimum requirement, and work specified or indicated on the drawings in excess of code requirements shall be provided.

Notify authorities and agencies; obtain all permits; obtain all official licenses and certificates; obtain all necessary approvals of authorities having jurisdiction; file all necessary plans; perform all necessary testing; and transmit to the Architect/Engineer all certificates of inspection.

Materials provided and work installed shall comply with the National Fire Codes of the NFPA; with the requirements of local utility companies; and with the requirements of agencies having jurisdiction.

Electrical materials and equipment shall be U.L. approved or listed. All electrical equipment shall be in compliance with the Energy Conservation Code and shall meet or exceed all operating energy efficiency requirements.

**FEES, PERMITS:**

Include the following costs within the bid amount;

The payment of all fees in connection with obtaining necessary permits, licenses, and inspections.

Note: All contractors and subcontractors must file for permits

The costs of all utility connections and extensions, to include the purchasing of meter(s) and appurtenances.

The payment of applicable taxes.

**SPECIAL REQUIREMENTS:**

This project requires that the building remain operational throughout the completion of renovations and alterations as indicated. See Contract documents and Division 01 for a complete knowledge of all special requirements.

**PART 2 - SUBMITTAL GENERAL REQUIREMENTS**

**SUBSTITUTIONS, CONTRACTOR'S OPTIONS:**

See Supplementary Conditions of the Contract for Construction.

Where only one product is specified, and the intention is to match existing equipment or materials within the mechanical system, the contractor shall submit his base bid on the product specified.

Where only one product is specified, but is followed by the phrase "or approved equal" the Mechanical Contractor(s) must submit his base bid on the product specified. Proposed substitutions for equivalent products shall be submitted for review under SUBSTITUTION PROPOSALS.

Where two or more products are specified for one use, the Mechanical Contractor(s) shall select from those products mentioned. Where specific model of one manufacturer is specified and other manufacturers are listed, the products of listed manufacturers must be equal in all major respect.

It remains the responsibility of the Mechanical Contractor to review the dimensions, weights, required clearances, required supporting structure, etc. of the equipment of "other" manufacturer's relative to the proposed use. The Mechanical Contractor is responsible for any changes to the design and to the building fabric (i.e. supporting structure, mechanical spaces, piping or ductwork connections and routing, etc.) resulting from the use of equipment of the "other" manufacturers.

**No proposal for extra charges resulting from the use of equipment of the "other"**

**manufacturers will be entertained for approval.**

Where products are specified by reference standard, select any product that meets the standards by any reputable manufacturer.

**SUBSTITUTION PROPOSALS:**

Refer to the Schedule of Submissions for the time period allowed for submission of substitution proposals. The proposal shall state the exact products proposed for substitution and include a cost difference in total savings to the Owner for each proposal.

Include in the proposal complete engineering data, shop drawings, samples and state whether related changes in the project are involved if the proposal is accepted.

No substitutions of products, materials or methods are permitted without written authority by the Architect/Engineer.

Where no substitution proposal is made within the specified time period, products, materials and equipment shall be submitted and installed as specified.

See Division 01 Specification Sections: Review additional requirements for substitutions.

**SUBMISSIONS:**

Refer to the SCHEDULE OF SUBMISSIONS below. Also refer to SUBMITTALS within other Sections of Division 23 in which some of the shop drawings to be submitted are listed. The listing is a minimum listing only. Submit lists of products and subcontractors; detailed drawings, catalog data of all products, equipment and materials required to complete the project and no item shall be ordered, delivered or installed until the reviewed shop drawing submittal is in the possession of the installing contractor.

**SCHEDULE OF SUBMISSIONS:**

<u>ITEM</u>	<u>TIME PERIOD</u>	<u>COPIES</u>
LIST OF SUBCONTRACTORS	10 days	7
LIST OF MANUFACTURERS/PRODUCTS	15 days	7
SUBSTITUTION PROPOSALS	20 days	7
SHOP DRAWINGS	25 days	7

Note: The time period above is based on the number of working days after the signing of the contract.

**LIST OF SUBCONTRACTORS:**

Submit a complete LIST OF SUBCONTRACTORS proposed for use; including complete firm names, address, and phone numbers.

**LIST OF MANUFACTURERS / PRODUCTS:**

Submit a complete LIST OF MANUFACTURERS of materials and equipment specified within this section proposed for use; including materials and equipment proposed by all subcontractors. **Partial lists will**

**not be accepted.**

**SHOP DRAWINGS:**

Provide shop drawings (drawings, catalog cuts, spec sheets) for ALL equipment and products to be installed on the project.

Label all shop drawing submittals as follows:

Project Name  
Contractor's Name  
Specification paragraph

Mark in ink all catalog cuts, pamphlets to indicate options, accessories and model numbers.

Data submitted which is general and not labeled and marked as required above will not be accepted.

**SHOP DRAWING REVIEW:**

Review will be based on manufacturer's published data, and ratings. Any product, material or equipment submitted not in accordance with these specifications will be rejected.

Where substitute products are proposed and no exception is taken, the Mechanical Contractor shall assume the entire responsibility for any changes in the work required or occasioned by the use of the substitute.

Review of shop drawings is not a guarantee of suitable measurements, quantities required, or that other changes in the work are not required to permit proper installation. Review does not mean the submittal has been checked for every detail, or that the Contractor is relieved from responsibility of providing complete systems as required by the Contract Documents.

**RECORD DRAWINGS:**

During the period of on site construction, keep at the site, separate from construction documents, accurate construction drawings marked to indicate actual installation of all work of all of the trades specified within Division 23. Drawings shall reflect addenda, change orders, VE items or substitutions accepted for the project. Drawings shall be "red lined" with all modifications on a weekly basis.

Final Record Drawings shall be prepared by the Mechanical Contractor on a set of reproducible drawings which accurately indicate all of the work as installed.

All adjustable setpoints shall be indicated on the drawings at the device sensor or point of adjustment.

**OPERATING AND MAINTENANCE MANUALS:**

Compile complete manuals including manufacturer's data, bulletins, maintenance instructions, approved shop drawings, parts lists, warranties etc for all equipment and materials provided.

Equipment data shall include:

Manufacturer / Models  
Input and output capacities  
Service and maintenance recommended actions  
Manufacturers published instructions

**Operations written narrative:**

Include a complete written narrative of how each system and component is intended to operate.

Assemble and index three copies of each manual within suitable binders (8 1/2" x 11"). Provide cover clearly indicating project title and "OPERATION AND MAINTENANCE MANUAL". Transmit manuals to the Architect/Engineer for review in advance of scheduled instruction periods.

**GUARANTEE:**

Transmit to the Architect/Engineer/Engineer a written guarantee from each of the Mechanical Contractors stating that the work provided under these specifications is guaranteed against defects in material and workmanship which shall become apparent during the period of one (1) year from acceptance of the systems.

The written guarantee shall list all contractors with contact names and phone numbers, and shall indicate the dates of acceptance of systems and any extended warranties.

The written guarantee shall be posted as directed by the Architect/Engineer/Engineer. Extended guarantee or warranty of certain equipment may be required. See specification of individual items.

**PART 3 - PRODUCT HANDLING**

**PROTECTION AND STORAGE OF MATERIALS:**

Equipment and materials furnished shall, at all times, be protected from weather, vandalism, and other construction phase exposures to include paint, plaster and dust. Outdoor storage of equipment not intended for outdoor use will NOT be permitted.

Properly protect all pipe openings with temporary caps to prevent obstruction and damage. Post notices and prohibit use of fixtures, equipment and apparatus prior to the completion of the project.

**RIGGING, HOISTING, STAGING:**

Furnish rigging, hoisting equipment, staging and other services necessary for delivery and installation of any product provided. Remove rigging, staging from the site when no longer required.

**PART 4 - PROJECT CONDITIONS**

**FIELD MEASUREMENTS AND DISCREPANCIES:**

Base all measurements, both horizontal and vertical, from referenced points established by the General Contractor. Prior to the start of work, check drawings and specifications for discrepancies. Field verify spaces, dimensions and clearances where materials and equipment will be installed. Where discrepancies arise which prevent or alter installation, notify the Architect/Engineer/Engineer.

Where discrepancies between drawings and specifications; between different drawings; or where the work of others is affecting work under this Division notify the Architect/Engineer/Engineer.

Where the work herein required is not clearly understood apply to the Architect/Engineer for further clarification.

In each instance above, the Architect/Engineer shall clarify the discrepancy and the Mechanical Contractor(s) shall complete the work at no additional cost to the Owner.

#### ACCESSIBILITY:

Install work so that parts requiring access are readily accessible for inspection, operation, maintenance, repair and removal. Minor deviations from the drawings may be made to accomplish this, but changes of magnitude shall not be made without written approval of the Architect/Engineer.

#### TEMPORARY OPENINGS:

Examine contract documents and ascertain whether special, temporary openings will be required for the installation of apparatus and notify the Architect/Engineer.

#### SOLDERING, BRAZING, WELDING:

Soldering, brazing, welding or other open flame operation shall be conducted only when a person, with approved firefighting equipment, trained in its use is on duty at the location of the operation.

#### INTERRUPTIONS TO SERVICES:

Where a temporary shutdown of an existing operating system is required, schedule the work at times designated by the Architect/Engineer. Work requiring an interruption shall be completed by continuous performance, including overtime, to minimize the shutdown interruption.

#### USE OF INSTALLATION BY OWNER:

The Owner may use parts of the installation, including mechanical systems when complete, but such use shall not be considered as acceptance of the work in lieu of written certificate from the Architect/Engineer.

Schedule obnoxious, noisy, or otherwise objectionable portions of the work at times approved by the Architect/Engineer. Overtime work must be approved in writing.

### **PART 5 - PRODUCTS AND INSTALLATION**

#### MATERIALS:

Provide new, first-class quality materials and apparatus, unless specifically directed otherwise by this specification or contract drawings.

#### ON-SITE INSPECTIONS

Arrange for and coordinate all on-site inspections with the authorities having jurisdiction.

Review project schedules and insure that such inspections as are necessary are completed in a timely manner.

**MANUFACTURER'S RECOMMENDATIONS, IDENTIFICATION:**

Obtain necessary data on equipment and materials to insure proper installation and testing in accordance with manufacturers' recommendations. Install all equipment and material per the recommendations and instructions of the manufacturer; this requirement shall take precedence over other requirements of this specification unless specifically noted.

Equipment and materials furnished for this work shall bear the manufacturers' nameplate, trademark or suitable identification permanently affixed. The nameplate of a contractor or distributor is not acceptable.

**COLOR SELECTION; MATERIALS / EQUIPMENT:**

Interior: Product color shall be selected by the Architect/Engineer. Provide complete color selection charts, chips with product submittals. Equipment to be painted shall have prime coat, anti-rust as necessary, factory applied.

**QUIET OPERATION:**

Equipment and apparatus provided shall operate under all conditions of load without sound or vibration which are considered objectionable by the Architect/Engineer/Engineer. Eliminate same in a manner approved by the Architect/Engineer/Engineer.

**ELIMINATION OF TRANSMISSION OF VIBRATION:**

Eliminate objectionable transmission of vibration from mechanical systems to building structure. Select and install equipment with proper vibration control equipment and provide isolators on piping, equipment, ductwork and apparatus where necessary to prevent transmission of sound and vibration. Isolate all rotating equipment from the building structure.

**BASES AND SUPPORTS:**

Provide all bases and supports for mechanical equipment not part of the building structure of required size, type and strength, as approved by the Architect/Engineer. Equipment, bases, and supports shall be anchored to the building structure to prevent shifting of position under all conditions. Attachments shall be strong and of a durable nature and any attachments, anchors, piers, bases, or other supports that are, in the opinion of the Architect/Engineer, not strong enough or durable shall be replaced as directed.

**SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS:**

Provide steel members, channels as required for the proper installation, mounting and support of equipment provided. Pipe shall not be allowed for use as miscellaneous steel supports. All steel used for support shall be firmly attached to the building construction. Size and type of supporting steel shall be determined by the installer and shall be of sufficient strength and size to allow only a minimum deflection under all conditions of load. All steel provided for support shall be free from rust and shall be primed with antirust paint or shall be galvanized. All exterior steel shall be galvanized.

#### SLEEVES, PLATES:

Provide and locate sleeves, plates, anchors, and inserts required; mark openings before floors and walls are constructed or core bored.

Provide sleeves for piping passing through floors, walls, roofs, partitions and masonry. Sleeves for concrete or masonry shall be Schedule 40 steel pipe of size to allow for pipe expansion and passage of vapor barrier insulation. Other sleeves shall be 20 gauge galvanized sheet steel with lockseam joint.

Terminate sleeves flush with walls, partitions, and ceiling.

Terminate sleeves 1/2" above finished floor where piping is exposed.

Provide support systems such that access to equipment or appurtenances requiring access are not impeded in any way.

#### PIPE ESCUTCHEONS:

Provide escutcheons for pipe penetrations of building construction exposed to view. Escutcheons shall closely fit bare or insulated pipe and shall conceal pipe sleeves. Escutcheons in unfinished areas shall be of solid or split pattern steel, cast iron or malleable iron. Escutcheons in finished areas shall be of chrome plated, solid pattern brass.

#### PORTABLE OR DETACHABLE PARTS:

Retain and be responsible for all portable or detachable parts provided as a part of the work. Install these parts just prior to project closeout when the site is secure. Replace all lost, stolen or damaged items prior to project acceptance.

#### LABELS, VALVE TAGS, PIPE, DUCTWORK, AND EQUIPMENT IDENTIFICATION:

All new systems provided as a part of the contract are to be labeled in a manner that conforms to the following specification. All existing systems, at points of new connection or reconfiguration, shall also be labeled in accordance with the following standards.

All labels, unless otherwise directed, shall be made of hard black plastic. Lettering shall be affected by engraving or incising, and shall be white. All labels shall be securely mechanically attached with screws or equal. Letters and numbers shall be at least 1/4" high, or larger, if required to read clearly from a normal viewing distance. All labels must be made to withstand the temperatures and atmosphere in the area they are to be mounted. Any labels which are to be mounted outdoors must be treated to prevent degradation from sunlight, and must be mounted with stainless steel screws.

Where air or hydronic systems have been balanced, the Contractor shall permanently mark, ON THE DEVICE, the correct balancing setting of each valve, damper, or similar device. This will allow our skilled tradesmen to restore proper operation if the device is tampered with.

All Mechanical Systems to be labeled in accordance with these requirements include, but are not specifically limited to, the following: Additional, specific items may require to be labeled as directed separately in other sections of this specification package.

Pipe Labeling:

Labels for piping shall be Seton Setmark or equal. Labels to identify zone number may be self-stick type, but must wrap completely around pipe, and be adhered to itself. All self-stick labels must be plasticized to withstand washing with commercially available cleaning products.

Piping labels shall be placed over any insulation on the pipe installed. Stenciling on the insulation jacket is not permitted, except as noted above.

For piping outside of Mechanical spaces; labels shall be placed every 40 linear feet of pipe. For piping within Mechanical spaces, labels shall be every 20 feet or as needed to provide clear and concise identification from the floor.

Label must show:

Fluid contained and service  
Flow direction  
Pressure (i.e. 50 psi)

Pipe Marker Lettering:

<u>Outside Diameter of Pipe Covering</u>	<u>Required Size of Lettering</u>	<u>Tag Length</u>
3/4" to 1-1/4"	1/2"	8"
1-1/2" to 2"	3/4"	8"
2-1/2" to 6"	1-1/4"	12"

Pipe Marker Color Standards:

<u>Pipe Line Type</u>	<u>Description</u>	<u>Background Color</u>	<u>Lettering Color</u>
Steam	Low Pressure Steam	Yellow	Black

Valve Tagging:

Labels for valves shall be hard plastic and shall be no smaller than 2" in diameter.

Tags shall have the valve number incised or recessed into the plastic. The tag background and tag lettering shall conform to the color scheme as defined by this standard.

All valve labels shall be permanently attached with steel or brass jack chain, tags shall be color coded to correspond to the following color chart, if product is not listed, consult the Architect/Engineer/Engineer.

Balancing Valves shall also be provided with tags, permanently marked, with the correct balancing setting. This will allow our skilled tradesmen to restore proper operation if the device is tampered with.

All valve labels must show a number that corresponds to a clearly posted valve legend.

Valve Tag Color Standards:

<u>Pipe Line Type</u>	<u>Description</u>	<u>Background Color</u>	<u>Lettering Color</u>
Steam	Low Pressure Steam	Yellow	Black

Equipment:

All pieces of equipment shall be labeled with hard plastic, black plate labels. Lettering shall be white and must be made by engraving or incising the plate.

Any unit which is designed to move volume air shall be appropriately labeled. The hard plastic plate shall show brand; model; system number and function; areas served; design CEM; type of sheave; voltage and phase of service; HP and frame of motor; number and size of belts.

EXAMPLE:      UNIT NUMBER: HVAC 1-1  
                     TRANE BU-15  
                     ZONE AC-1 / AIR COND / 21,000 CFM  
                     ADJ Shv - 5 HP - 208/3  
                     FRM - (3) 4L190 BELTS  
                     THIRD FLOOR NORTH

Show unit number as stated on the Drawings.  
HVAC unit tags shall also state unit service or function.

Automatic Control / Temperature Control Devices:

Show, AT THE LOCATION OF THE DEVICE, tags indicating the type of device or accessory, i.e. temperature, humidity, pressure and current sensors; freezestats; etc. Identify device function.

Automatic Control Systems Electrical Conduits:

Labeling for conduit shall be factory-made. Painting or stenciling is not acceptable. Lettering shall include the highest voltage carried within, and shall identify phase. Labeling shall repeat every 30 linear feet. Adhesive backed labels are acceptable here provided the label wraps around the entire circumference of the conduit, and adheres to itself. Otherwise, mechanical fastening with strap is required.

**PART 6 - PROJECT CLOSEOUT**

TESTING AND ADJUSTING:

Where testing leaks develop or the installation fails to function properly, make all necessary corrections and repeat tests until all defects have been remedied. Corrections made shall be to the satisfaction of the Architect/Engineer prior to the acceptance of the work.

Furnish labor, material, and instruments necessary for those tests required. See respective Sections for test requirements.

In addition to required tests specified, provide qualified personnel to adjust all parts of systems such that proper, economical operation is achieved.

Conduct and be responsible for all testing and adjusting of all complete systems to include providing all labor and equipment required and the submission of all reports. Systems shall be operated, tested and adjusted in all modes of operation.

All defects and deficiencies or failing to operate properly shall be corrected by the Contractor and the systems shall be re-tested or readjusted prior to final acceptance.

Any and all damage caused by tests shall be the responsibility of the Contractor.

The balancing of the air conditioning systems shall be performed by an independent balancing contractor.

SEE SECTION 23 95 00 TESTING AND BALANCING.

#### SEASONAL SYSTEM TESTS: HVAC

Scope: In addition to other testing and adjusting specified within; and subsequent to the final testing and balancing, all HVAC systems shall be tested to indicate that performance of all units is satisfactory and as intended.

Heating and Ventilating: All systems shall be tested and adjusted for proper operations when the first winter like weather conditions are present.

Air Conditioning System: The entire air conditioning system shall be tested at the first occurrence of summer like weather following project completion; and it shall be established that all controls are performing satisfactorily, and that all units are providing a satisfactory level of cooling. The system shall be checked for vibration and excessive noise, and any such conditions shall be corrected.

#### OPERATION, MAINTENANCE INSTRUCTIONS:

Schedule and conduct, after the mechanical -- electrical systems are complete and operational, instruction periods for Owner's personnel. Operation and Maintenance Manuals shall be distributed to the Owner in advance of scheduled instruction periods.

Instruction periods shall include:

- Normal and emergency start up and shut down of all systems
- Normal maintenance requirements for all systems and equipment
- Maintenance tasks and schedules for proper operation.
- Review of Operations and Maintenance Manuals
- Review of AS BUILT drawings

In addition to instruction periods; a thorough project walk through shall be conducted and the location and access to all points of operation, control and maintenance shall be indicated and noted.

At the completion of instruction periods forward a letter (5 copies) stating the names of those giving and receiving instructions.

#### LUBRICATION:

Lubricate, as required, all motors, bearings, fans, etc. before operation of any equipment. Provide a final lubrication when system is accepted by Owner.

#### CLEANING:

At completion, thoroughly clean all parts of the installation. Equipment, materials and apparatus shall be free of grease, paint, plaster and debris. Any damage to the building due to leakage or by other means

shall be properly and immediately cleaned and repaired to the satisfaction of the Architect/Engineer.

At completion, replace, clean, such parts of systems as filters, strainers, and traps. This work shall be done after site is substantially free of dust.

**SCRATCHES, SCRAPES, DENTS:**

Repair and correct, to the satisfaction of the Architect/Engineer, all minor equipment deficiencies such as scratches, scrapes, dents; where corrective methods are not satisfactory, replace the item.

**PROJECT CLOSEOUT SUBMITTALS:**

Review all project closeout submittal requirements of this specification and transmit in a timely manner. Provide all required items including (but not limited to):

- Record As Built Drawings
- Written Guarantee including any extended warranties
- Operating / Maintenance Instructions Memorandum
- Testing / Adjusting Logs

**SERVICE:**

At completion, provide the Architect/Engineer with a complete listing of all service contractors including 24-hour phone numbers. Provide service on equipment furnished for a period of one year from the date of final acceptance. Render service promptly at the request of the Owner. This shall not be construed to include routine maintenance.

**END OF SECTION 23 00 00**

**SECTION 23 00 40 - MECHANICAL: DEMOLITION**

**PART 1 - GENERAL**

**RELATED DOCUMENTS:**

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and Section 23 00 00 Mechanical General Requirements, and the following listed sections as a minimum, apply fully to work in this section.

Refer to all Section 23 00 00 Mechanical General Requirements and coordinate all work with the work of the following listed Sections.

Section 23 00 00      MECHANICAL GENERAL REQUIREMENTS

Refer to and coordinate all work with the work of the following listed Sections:

Section 23 00 50      MECHANICAL: ELECTRICAL COMPONENTS

Section 23 54 50      MECHANICAL: STEAM SYSTEMS

Section 23 85 00      HVAC: EQUIPMENT

Section 23 90 00      HVAC: CONTROL SYSTEM / DIGITAL

**DESCRIPTION OF WORK**

Provide removal, relocation, rerouting and reconnecting of existing mechanical facilities, as shown and as required by contract documents, to accomplish alteration, restoration and to accommodate new construction.

Including but not limited to the following:

Demolition and removal of selected parts of mechanical systems.

Removal of debris and materials from the project site

Salvage of existing items and delivery to Owner.

All demolished materials and equipment are to be removed from the site and disposed of in an approved manner. Recycle materials where required.

**QUALITY ASSURANCE**

Reference Standards - Comply with the following:

American National Standards Institute (ANSI): Safety Requirements for Demolition - ANSI A 10.6.

National Fire Protection Association (NFPA): Safeguarding Building Construction and Demolition Operations - NFPA 241.

US Environmental Protection Agency (EPA)

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The Federal Register - Emissions Standards for Hazardous Air Pollutants - 40 CFR-81.

Local city and state safety regulations including transportation and disposal regulations.

**DEFINITIONS:**

**Remove:** Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

Salvage in first paragraph below may add cost to Project; verify with Owner.

**Remove and Salvage:** Detach items from existing construction and deliver them to Owner.

**Remove and Reinstall:** Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

**Existing to Remain:** Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

**PREDEMOLITION CONFERENCE:**

**Predemolition Conference:** Conduct conference at Project site.

Review methods and procedures related to selective demolition including, but not limited to, the following:

Inspect and discuss condition of construction to be selectively demolished.

Review structural load limitations of existing structure.

Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.

Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

Review areas where existing construction is to remain and requires protection.

**SUBMITTALS:**

**Schedule of Selective Demolition Activities:** Indicate the following:

Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.

Interruption of utility services. Indicate how long utility services will be interrupted.

Coordination for shutoff, capping, and continuation of utility services.

Use of elevator and stairs.

Locations of proposed dust- and noise-control temporary partitions and means of egress.

Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

Means of protection for items to remain and items in path of waste removal from building.

**PROJECT CONDITIONS:**

Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

Provide not less than 72 hours notice to Owner of activities that will affect Owner operations.

Review first paragraph and subparagraph below and revise if necessary. In subparagraph, include list of items that will be removed by Owner.

Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

**Hazardous Materials:** It is not expected that hazardous materials will be encountered in the Work. Retain subparagraph below to cover instances where hazardous materials are unexpectedly found and must be remediated.

If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.

Storage or sale of removed items or materials on-site is not permitted.

**Utility Service:** Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

Maintain fire-protection facilities in service during selective demolition operations.

**PART 2 - PRODUCTS**

**DESCRIPTION:**

Provide all materials, equipment and labor necessary to perform the demolition as required.

For materials required for this work, comply with the applicable specification sections in Division 23.

**PART 3 - EXECUTION**

**PREPARATION:**

**Site Access and Temporary Controls:** Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

Cover and protect furniture, furnishings, and equipment that have not been removed.

Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."

Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

Strengthen or add new supports when required during progress of selective demolition.

#### GENERAL:

Provide alteration and demolition of mechanical facilities as required by the drawings and specifications.

Do not begin work until time schedules and manner of operations have been approved by the Owner's Representative.

All interruptions of existing services shall be included in the Owner approved schedules, and so identified.

Verify the location of all related existing equipment, piping and other mechanical facilities. Provide for the removal, relocation, rerouting and reconnecting of this work as required because of demolition methods or sequences employed. Obtain the Owner's permission prior to commencing any work.

Comply with the installation procedures specified in the applicable specification sections in Division 23.

Where existing equipment must remain in service during construction, provide rerouting and reconnecting of mechanical services as required to maintain continuous service.

Maintain system continuity and operation of piping or ductwork circuits, whether spliced, extended, relocated or newly constructed.

Store, on the site, materials and equipment to be salvaged for future use by the Owner.

All piping hangers, supports, anchors, etc., shall be removed along with all ductwork and piping shown to be removed.

Where equipment and piping is removed or disconnected under DIVISION 23, perform the work in

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such a manner that no damage is done to the structure or remaining portions of the existing systems. Do not under any circumstances place a stress on existing ductwork or pipe and fittings which are to be reused. Be fully responsible for and repair, at no additional expense to Owner, any leaks developing in existing piping or ductwork due to failure to take proper precautions when making alterations.

**PIPING:**

All welded piping shall be cut off square at the locations indicated on the demolition drawings. All openings of any remaining valves, piping or fittings shall be closed off with weld caps or blind flanges to prevent debris from entering the existing systems.

All threaded piping shall be disconnected at the location indicated on the demolition drawings. All openings of remaining valves, piping, fittings and equipment shall be closed off with pipe plugs or pipe caps as required to prevent debris from entering the existing systems.

All pipe hangers, supports, and/or anchors shall be removed along with all piping shown to be removed.

Provide shutoff valves to isolate new work from existing and temporary or permanent connections to new work as required for proper testing and cleaning of new work.

**DUST CONTROL:**

Provide dust barriers as necessary to control the migration of dust during demolition of spaces.

Provide temporary ventilation of all spaces during demolition work.

**INSULATION:**

Insulation shall be removed from all piping, fittings, valves and equipment designated for demolition.

Comply with all safety precautions related to insulation removal.

**CLEANING:**

Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

**END OF SECTION 23 00 40**

**SECTION 23 00 50 - HVAC: ELECTRICAL COMPONENTS**

**PART 1 - GENERAL**

**RELATED DOCUMENTS:**

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and Section 23 00 00 Mechanical General Requirements, and the following listed sections as a minimum, apply fully to work in this section.

Refer to all construction documents including all of the Sections of Division 23 for a complete understanding of the electrical components required. Coordinate with all trades.

Section 23 00 00           MECHANICAL GENERAL REQUIREMENTS

Refer to and coordinate all work with the work of the following listed Sections:

Section 23 54 50           HVAC: STEAM SYSTEMS

Section 23 85 00           HVAC: EQUIPMENT

Section 23 90 00           HVAC: CONTROL SYSTEM / DIGITAL

Section 23 95 00           HVAC: TESTING AND BALANCING

**SCOPE:**

Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.

**RELATED WORK:**

Work in conjunction with this section shall be as designated below:

**General Contractor:**

Cutting, Patching, and Painting  
Openings in walls  
Equipment foundations and bases

**Electrical Contractor:**

Power wiring for electrical equipment provided within this section.

**PROJECT ADMINISTRATION:**

Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect/Engineer.

Prepare and transmit to the Architect/Engineer all submittal requirements within the time period allowed. See Schedule of Submissions.

**SUBMITTALS:**

See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.

The following submittals shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSIONS in Section 23 00 00): (The list below is not intended to be all inclusive. Provide submittals for all materials and equipment proposed for use on this project.)

**PROJECT CLOSEOUT:**

Review and provide closeout requirements of this section and Section 23 00 00 Mechanical General Requirements, including:

- Testing and Adjusting
- Record Drawings
- Operating, Maintenance Instructions
- Written Guarantee
- Lubrication, Filters
- Operating, Maintenance Manuals
- Cleaning
- Test Log
- Letters of compliance.

**PART 2 - ELECTRICAL PRODUCTS / DATA**

**GENERAL:**

Provide new, standard products, materials and equipment which comply with the specification; are undamaged and unused at the time of installation; are complete with accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use.

**COMPONENT INSTALLATION:**

Provide the electrical components to the electrical equipment installer for mounting and installation.

Combination Electric Motor Starters and Variable Frequency Drives shall not be mounted directly on any mechanical piece of equipment unless specifically indicated on the mechanical drawings.

**EQUIPMENT MINIMUM EFFICIENCIES (SEER)**

All equipment proposed for installation shall be in compliance with the current energy code requirements.

**ELECTRICAL CURRENT CHARACTERISTICS:**

Refer to the Electrical Drawings and field coordinate the electrical components of the mechanical systems specified in this Division.

Motors: Smaller than 1/2 HP                      120V, 1 phase

**ELECTRICAL CONNECTIONS AND WIRING:**

The Electrical Contractor shall provide power wiring complete from power source to motor or equipment junction, including power wiring through starters and line voltage control apparatus. The Mechanical Contractor(s) shall furnish and the Electrical Contractor shall install all electric motor starters.

The mechanical/temperature controls contractor(s) shall provide all wiring, relays, transformers, devices, etc. necessary (regardless of voltage) for automatic controls.

Wiring provided by Mechanical Contractor(s) shall be in accordance with the National Electric Code, local and state codes and Division 016. Wiring shall be in conduit, regardless of voltage, unless noted otherwise.

**ELECTRICAL DEVICE COORDINATION:**

Do NOT operate electrical devices until:

- Voltage available on all phases is in accordance with nameplate.
- Direction of rotation is checked.
- Full load voltage reading is not less than nameplate.
- Full load amperage reading is not greater than nameplate.

**END OF SECTION 23 00 50**



Supported Equipment	AHU-1
Isolator Type	Mason SLF
Equipment Weight	4900 lbs.
Lowest Speed	800 RPM
Schedule Deflection	2.5 inches
Operating Deflection	2.6 inches
Spring Free height	9.6 inches
Operating Height	7.0 inches
Solid Height	5.6 inches
Spring Height	6.2 inches
Remarks:	

Reports: Provide inspection reports from the isolator manufacturer or representative indicating that the installations are complete and correct in every respect.

Shop Drawings: submit shop drawings and manufacturer's installation instructions for thrust restraints wherever they are required.

Submission of samples may be requested for each type of vibration isolator device. After approval, samples will be returned for installation at the job. All costs associated with submission of samples shall be borne by the Contractor.

#### DRAWINGS:

Detailed drawings are schematic only. The size and number of mounts and hangers shall be chosen to meet these specifications.

### **PART 2 – PRODUCTS**

#### GENERAL REQUIREMENTS:

Steel springs and neoprene elements shall have static deflections under operating load equal or greater than deflections shown on the schedules. Isolators submitted on the basis of rated loads will be disapproved.

All steel springs as installed shall have minimum additional travel to solid (coil bind) equal to 50% of the deflection under operating load.

Spring diameter shall be no less than 0.8 of the compressed height of the spring at operating load.

All neoprene components shall be selected for maximum hardness of 40 durometer, show A rating where possible. In no case shall hardness exceed 50 durometer. Bridge bearing quality neoprene meeting AASHTO Highway Bridge Specifications shall be used in all elastomeric components where installed in irretrievable locations and as noted elsewhere in the documents.

All isolators supporting a given piece of equipment shall be selected for approximately equal spring deflection.

Steel springs shall not take a permanent set when compressed to coil bind.

Steel springs shall be color-coded to allow positive identification after installation.

**CORROSION PROTECTION:**

All vibration isolators and associated hardware shall be designed or treated for resistance to corrosion.

**VIBRATION ISOLATOR TYPES:**

**Type A:** Elastomeric pads shall be waffled or ribbed neoprene pads Mason model Super W., Amber-Booth model NR, Kinetics model NP or approved equal; or ribbed or waffled neoprene pads with steel shim plate Mason model WSW, Amber-Booth model SP-NR style E. or approved equal. Size pads for deflection equal to 10-20% of unloaded height; bridge bearing quality pads shall be loaded 10-15%.

**Type E.** Restrained open spring floor mount isolators for windy rooftop locations and/or for equipment with operating weight greater than installed weight shall have built-in adjustable limit stops to prevent equipment from rising when weight is removed. Isolators shall be as Type D above plus height-limiting studs and adjustable nuts, with ½ inch minimum clearance around the studs. Isolators shall be Mason model SLR, Amber-Booth model CT, Kinetics model FLS or approved equal.

**Type G:** Spring-and-neoprene-in-series hangers shall contain a steel spring and 0.3 inch deflection elastomeric element in series. Neoprene elements shall be molded with a rod isolation bushing that passes through the hanger box. The diameters of the spring and the hole in the mounting box shall allow for 15 degree misalignment from vertical before mechanical short circuit occurs. Isolators shall be Mason model 30N, Amber-Booth model BSRA, Kinetics model SRH or approved equal.

Elastomeric grommets may be a combination of neoprene washer and busing, Mason models HLIW and HLIB or approved equal. Elastomeric grommets shall be 60 durometer maximum and shall be formed to prevent bolts from directly contacting the secured item.

Captive neoprene wall-mount isolators shall be Mason model RBA, RCA, or approved equal.

Reference electrical specification for flexible conduit specification.

**PART 3 – EXECUTION**

**MANUFACTURER'S RESPONSIBILITY:**

The vibration isolation manufacturer or his authorized representative shall alert the Engineer to any isolator selections which may experience resonance with the approved equipment and upgrade any isolators that are found to resonate with the supported equipment. He shall provide supervision as may be necessary to assure correct installation and adjustment. He shall submit a written report to the Architect at completion of the Work, certifying correctness of the installation and compliance with Contract Documents.

**GENERAL:**

All equipment and piping shall be resiliently mounted on or suspended from approved foundations and supports, with isolation pads, mounts and hangers as specified herein and as shown on drawings. Contractor shall cooperate with the Architect to replace any isolators that need to be upgraded from what is shown on the drawings if equipment operating results in resonance with building natural frequencies.

**MOUNTS AND HANGERS:**

Location of all vibration isolation equipment shall be selected for ease of inspection and adjustment as well as proper operation.

Installation of vibration isolation equipment shall be in accordance with the manufacturer's instruction.

All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.

Isolators for equipment with bases shall be located on the sides of the bases that are parallel to the equipment shaft unless this is not possible because of physical constraints.

Hanger rods for vibration isolated support shall be connected to structural beams or joists, not from the floor slab between beams and joists. Provide intermediate support members as necessary.

Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure so that the hanger housing may rotate a full 360 degrees about the rod axis without contacting object.

Adjust all leveling bolts and hanger rod so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.

Limit stops shall be out of contact during normal operation.

Parallel pipes may be hung together on a trapeze that is isolated from the structure. Isolator deflections must equal the greatest deflection for the grouped pipes if isolated individually. Do not mix isolated and non-isolated pipes on the same trapeze.

**DEFLECTIONS:**

Vibration isolation systems shall be designed to have deflections equal to or greater than indicated on the schedule and drawings. Where multiple deflection requirements apply to a single isolator, the greater deflection shall prevail. Isolators supporting asymmetrical loads shall be selected for equal deflection under actual load. The number of mountings and sizes shall be determined by the vibration isolation manufacturer, and shall be installed in accordance with manufacturer's instructions.

**CORROSION RESISTANCE:**

Treat isolation systems for corrosion resistance. Coatings damaged during installation shall be repaired.

**INDEPENDENT SUPPORTS:**

Isolated systems shall be independent. Piping, ductwork, conduit or mechanical equipment shall not be hung from or supported on other equipment, pipes or ductwork installed on vibration isolators. Maintain 2" clearance between isolated equipment and walls, ceilings and other equipment. Drain piping connected to vibration isolated equipment shall not contact the building structure or other non-isolated systems.

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consulting engineers

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UNIT VENTILATOR REPLACEMENT PROJECT

**SUPPORT PIPES AS FOLLOWS:**

For all pipes over 1" in diameter, provide metal sleeves sized for  $\frac{1}{4}$ " to  $\frac{1}{2}$ " clearances at wall and slab penetrations, and seal tightly in place. Pack with fiberglass insulation, and caulk airtight at each end of the sleeve.

**END OF SECTION 23 01 50**

**SECTION 23 02 50 MECHANICAL: PIPE HANGERS AND SUPPORTS**

**PART I GENERAL**

**RELATED DOCUMENTS:**

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and the following listed sections as a minimum, apply fully to work in this section.

Section 23 00 00      MECHANICAL GENERAL REQUIREMENTS

Refer to and coordinate all work with the work of the following listed sections:

Section 23 01 50      MECHANICAL: VIBRATION ISOLATION  
Section 23 03 00      MECHANICAL: FIRE SAFING  
Section 23 04 00      MECHANICAL: INSULATION  
  
Section 23 54 50      HVAC: STEAM SYSTEMS  
  
Section 23 85 00      HVAC: EQUIPMENT

**SCOPE:**

Section Includes: Pipe hangers and supports, pipe saddles and shields, and pipe guides and anchors for piping systems except for fire protection piping systems.

**PROJECT ADMINISTRATION:**

Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.

Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

**SUBMITTALS:**

See SUBMITTAL GENERAL REQUIREMENTS within Section 23 00 00.

The following shop drawings shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSIONS in Section 23 00 00): (The listing below is not intended to be all-inclusive. Provide submittals for all materials and equipment proposed for use on this project.)

Product data sheets: Provide product data sheets for all hangers and supports intended for use on the project.

Pipe Hangers  
Hanger Rod  
Structural Attachments  
Insulation Shields

**QUALITY ASSURANCE:**

Pipe hangers, pipe supports, hanger and support accessories, pipe saddles and pipe shields, where applicable, shall comply with provisions of latest edition of ASME Code for Pressure Piping ANSI/ASME B31.1 - Power Piping, Fed. Spec. No. WW-H171, Manufacturers' Standardization Society Standard Practice SP-58 and SP-69, and these Specifications. Where there is conflict, these Specifications shall govern.

Hangers, supports, accessories, saddles and shields shall be load-rated. Load ratings shall be established by manufacturers based upon testing and analysis in conformance with above referenced codes. Manufacturers load tests shall be made on both supporting materials and configurations. Tests shall be performed by independent testing laboratory. Results of these tests shall be made available to the Owner upon request.

Manufacturers shall select hangers, supports, accessories, saddles and shields based on load ratings for applications involved.

**PART 2 PRODUCTS**

**PIPE HANGERS AND SUPPORTS:**

Manufacturer(s) Specified:

Grinnell Corp.  
Carpenter & Paterson, Inc.  
Michigan Hanger Co., Inc.  
Penn Pipe Hangers Div. of Penn Construction Industries  
Power Piping Co.  
Basic Engineers, Inc.  
National Pipe Hanger Corp.  
B-Line Systems, Inc.

General Requirements:

Pipe hangers, supports and accessories specified herein are from master specifications and include hangers, supports and accessories for various piping materials and applications. Refer to related Sections for actual piping materials required for the Project and select hangers, supports and accessories for applications involved.

Auxiliary structural steel, not part of building structure, required for support of piping shall be as required and necessary. Provide unistrut of strength required. Pipe used as supports is not acceptable. All metal surfaces shall be painted. Metal exposed to weather shall be galvanized.

Unless otherwise shown or specified, hangers, supports and accessories for insulated piping systems shall be sized to accommodate pipe insulation system, and shall fit around outside of pipe insulation without crushing and penetrating pipe insulation. Refer to specifications for piping insulation for detailed specifications of insulation and inserts at hangers and supports.

Hangers, supports and accessories exposed to weather or corrosive environments shall be protected with factory-applied corrosion-resistant finish. Provide galvanized or cadmium-plated finish except when it is specified that components and assemblies are to be constructed of stainless steel, or copper-plated steel.

Certain piping shall be resiliently supported. Refer to requirements for vibration isolation.

Upper Attachments:

Hanger rod shall be threaded steel, Grinnell Fig. 146 or 140.

Rod couplings shall be steel, Grinnell Fig. 135.

Extension pieces shall be malleable iron, Grinnell Fig. 157

Eye rods shall be threaded steel, Grinnell Fig. 248.

U-bolts shall be steel, Grinnell Fig. 137 with nuts.

Pipe Attachments:

Hangers for bare steel pipe 2" and smaller shall be Grinnell Fig. 65 light-duty steel clevis hangers. For 2-1/2" and larger use Grinnell Fig. 260 standard-duty steel clevis hangers.

Risers:

Riser clamps for bare steel pipe 20" and smaller shall be Grinnell Fig. 261 steel riser clamps. Weld support lugs on pipe 4" and larger.

Supports:

Supports for bare steel run vertically on walls shall be Grinnell Fig. 103 offset pipe clamp, unless shown or specified otherwise.

Supports for bare steel 1-1/2" and smaller, run vertically on walls in finished areas, shall be Carpenter & Paterson Fig. 68 adjustable stamped brass hanger with concealed threaded post and polished brass finish.

Supports for insulated pipe and tubing 12" OD (pipe and insulation combined) and smaller, run vertically on walls shall be Grinnell Fig. 103 offset pipe clamp, unless shown or specified otherwise.

PIPE SADDLES, PIPE SHIELDS AND INSERTS:

Manufacturers:

Pipe Saddles and Shields with Inserts:

Grinnell Corp.  
Carpenter & Paterson, Inc.  
Michigan Hanger Co., Inc.  
Penn Pipe Hangers Div. of Penn Construction Industries  
Power Piping Co.  
Basic Engineers, Inc.  
National Pipe Hanger Corp.  
B-Line Systems, Inc.

Preinsulated Pipe Shields

Pipe Shields, Inc.  
Basic Engineers, Inc.  
Power Piping Co.  
B-Line Systems, Inc.

General Requirements:

Provide the following at pipe hangers and supports:

Pipe saddles on hot insulated black steel piping systems 2-1/2" and larger.

Either inserts with pipe shields or preinsulated pipe shields for other insulated piping systems as defined herein.

Pipe saddles and inserts with pipe shields shall be of sufficient length for applications involved.

When pipe saddles, inserts with pipe shields and preinsulated pipe shields are used in conjunction with roller type hangers and supports, length shall be sufficient to keep rolling point of contact at least 3" from both ends of pipe saddles, pipe shields and inserts and preinsulated pipe shields.

Pipe saddles and inserts with pipe shields shall be selected and sized to accommodate supported loads. Spacing of pipe hangers and supports may have to be adjusted accordingly; refer to Article, Pipe Hangers and Supports herein.

Pipe saddles and inserts shall be same thickness as adjacent piping insulation system.

Preinsulated pipe shields shall be used as follows:

Preinsulated pipe shields shall be used on insulated piping and tubing systems (except foamed plastic closed-cell type) whenever supported loads exceed ratings of materials specified under Paragraphs, Inserts and Pipe Shields herein.

Use of preinsulated pipe shields is optional for other applications.

Coordinate with insulation subcontractor and the Work specified in Section 23 04 00  
MECHANICAL INSULATION.

Insulation Shields:

Provide galvanized steel insulation shields at locations of pipe hangers for piping systems with ID less than 2". Insulation shields shall extend 6" on either side of hanger and shall be with rounded edges.

Inserts:

Select inserts for insulated piping systems for placement directly at pipe hanger and support locations. Inserts shall be placed in direct contact with piping. Inserts shall have acceptable proportion of sodium plus silicate ions to chloride ions to prevent corrosion.

**PART 3 EXECUTION**

**PIPE HANGERS AND SUPPORTS:**

General:

Supports shall secure pipes in place, prevent swaying and vibration, maintain required grading by proper adjustments and provide for expansion, contraction, anchorage and piping insulation protection. Design supports of strength and rigidity to suit loading and service. Include weight of water and fluids wed for cleaning and testing. Supports shall not unduly stress building construction.

Installation of pipe hangers and supports shall conform to:

Manufacturers Standardization Society (MSS) Standard Practice:

SP-69 Pipe Hangers and Supports - Selection and Application

In case of conflict, more stringent requirements shall apply.

Hanger and Support Spacing:

Pipe hangers and supports shall be selected and spaced on basis of building structure, loading limitations, imposed loads, and pipe stress. Tables below are based on pipe stress only.

Maximum pipe hanger and support spacing dimensions specified or listed herein are for bare pipe without additional loads such as flanges, valves, piping specialties, accessories, insulation or other forces. Certain spacing dimensions are recommended by piping manufacturers or are accepted good practice. Reduce spacing from maximums shown or specified as required to accommodate actual imposed loads of piping systems in conjunction with load limitations of building structure and elements of pipe hanger and support systems including pipe saddles, pipe shields and inserts.

Maximum spacing of hangers and supports for standard weightsteel pipe shall conform to requirements of ANSI/ASME B31.1 - Power Piping and Manufacturer's Standardization Society Standard Practice (MSS) SP-69. Pipe Hangers and Supports for reference as follows:

Pipe Size Inches	Maximum Spacing	Maximum Spacing
	Feet Water Service	Feet Vapor Service
½ and smaller	7	8
¾, 1, 1-1/4	7	9
1-1/2	9	12
2	10	13
2-1/2	11	14
3	12	15

Provide supports for riser (vertical) piping at each floor except where shown or specified otherwise.

Intermediate Attachments

Attachments shall be selected on basis of building structure and loads to be supported. Maximum applied loads shall not exceed manufacturer's published load data. Install per manufacturer's instructions.

Pipe Attachments

Do not hang one pipe from another nor from ductwork and conduits. Do not use perforated band iron, wire nor chain as hangers.

Unless otherwise specified or shown on the Drawings, piping shall be suspended by individual hangers.

Drainage piping shall be suspended by individual hangers only.

Where piping must be suspended closer to overhead than is possible with single rod clevis hangers, trapeze supports shall be used as specified further herein.

At pipe bends, place hanger no more than 1/2" from bend.

Apply double wraps of 3M Co. No. 51 Scotchwrap PVC tape with pressure-sensitive adhesive around bare piping where piping materials are dissimilar from pipe attachments. Scotchwrap is not required where pipe attachments are specified to have protective coating or match piping material being supported.

Select and install pipe attachments to permit expansion and contraction.

#### PIPE PIPE SHIELDS AND INSERTS:

Install pipe shields on flexible foamed insulation such that shield is centered under insulation inserts. Coat inserts with compatible wet adhesive and insert into snugly cut undersized holes in pipe insulation. Stabilize large and heavy pipes with additional inserts (hardwood dowels) at 4 and 8 o'clock positions. After installation, coat outer surface and vapor-seal with adhesive, then apply layer of pressure-sensitive adhesive vapor barrier tape.

Install and orient highest density insulation section of preinsulated pipe shields to bottom of pipe and assemble as directed by manufacturer of preinsulated pipe shields.

**END OF SECTION 23 02 50**

**SECTION 23 04 00 - MECHANICAL INSULATION**

**PART 1 GENERAL**

**RELATED DOCUMENTS**

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 and the following listed sections as a minimum, apply fully to work in this section.

Section 230000           MECHANICAL GENERAL REQUIREMENTS

Refer to and coordinate all work with the work of the following listed sections:

Section 230250           MECHANICAL: PIPE HANGERS AND SUPPORTS  
Section 230300           MECHANICAL: FIRE SAFING

Section 235450           HVAC: STEAM SYSTEMS

Section 238500           HVAC: EQUIPMENT

**SCOPE**

Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.

Work includes but is not limited to:

Hot Piping systems insulation

**RELATED WORK**

Work in conjunction with this section shall be as designated below:

General Contractor:

Cutting, Patching, and Painting  
Flashing  
Openings in walls  
Equipment foundations and supports  
All temporary heating

**PROJECT ADMINISTRATION**

Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect.

Prepare and transmit to the Architect all submittal requirements within the time period allowed. See Schedule of Submissions.

## SUBMITTALS

See SUBMITTAL GENERAL REQUIREMENTS within Section 230000.

The following shop drawings shall be prepared and submitted for approval within the time period stated (see SCHEDULE OF SUBMISSIONS in Section 230000): (The list below is not intended to be all-inclusive. Provide submittals for all materials and equipment proposed for use on this project.)

- Piping Insulation, All Systems
- Duct Insulation, All Systems
- Vapor Barrier Materials

### General Materials:

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included. Materials furnished under this section of the specification shall be submitted at one time.

Provide a schedule for each system including the following:

- Material
- Thickness
- "k" value
- Density
- Finish
- Jacket

### Samples:

Thermal Insulation Materials: After approval of materials, actual sections of installed systems, properly insulated in accordance with the specification requirements, shall be displayed. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The Owner will inspect display sample sections at the jobsite. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

## SYSTEM DESCRIPTION

Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated.

Insulation Systems are as follows:

Anti Sweat	AS
Heat Conservation:	HC
Cold Conservation:	CC
Energy Conservation	EC
Personal Protection:	PP

Piping Systems – Insulation systems are as follows:

Low Pressure Condensate	AS/CC
Low Pressure Steam	HC

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. At the discretion of the Owner, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

American Society for Testing And Materials (ASTM)

ASTM C 1136 (1995) Flexible, Low Permeance Vapor Retarders for Thermal Insulation

ASTM C 195 (1995) Mineral Fiber Thermal Insulating Cement

ASTM C 449/C 449M (2000) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement

ASTM C 647 (1995; R 2000) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation

ASTM C 920 (2002) Elastomeric Joint Sealants

ASTM C 921 (1989; R 1996) Determining the Properties of Jacketing Materials for Thermal Insulation

ASTM D 882 (1997) Tensile Properties of Thin Plastic Sheeting

ASTM E 84 (2001) Surface Burning Characteristics of Building Materials

ASTM E 96 (2000e1) Water Vapor Transmission of Materials

## GENERAL QUALITY CONTROL

### Standard Products:

Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

### Installer's Qualifications:

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

### Surface-Burning Characteristics:

Unless otherwise specified, insulation not covered with a jacket shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Insulation materials located

exterior to the building perimeter are not required to be fire-rated. Flame spread, and smoke developed indexes, shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

Identification of Materials:

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

STORAGE

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Owner may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means.

**PART 2 PRODUCTS GENERAL**

GENERAL MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

Contact Adhesive

Adhesives may be dispersed in a volatile organic solvent. Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in the dry state in accordance with ASTM E 84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation shall be used to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

Corner Angles

Nominal 0.016 inch aluminum 1 x 1 inch with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

#### Finishing Cement

ASTM C 449/C 449M: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must include testing per ASTM C 795.

#### Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with ASTM E 84. Tape shall be 4 inch wide rolls.

#### Staples

Outward clinching type ASTM A 167, Type 304 or 316 stainless steel. Monel is a nickel rich alloy that has high strength, high ductility, and excellent resistance to corrosion.

#### Jackets

ASTM C 921, Type I, maximum moisture vapor transmission 0.02 perms, (measured before factory application or installation), minimum puncture resistance 50 Beach units on all surfaces where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C 921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require factory applied jackets are mineral fiber, cellular glass, and phenolic foam. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

#### White Vapor Retarder All Service Jacket (ASJ)

For use on hot/cold pipes, ducts, or equipment vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

#### Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

#### Vapor Retarder Mastic Coatings

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. All other application and service properties shall be in accordance with ASTM C 647.

#### Laminated Film Vapor Retarder

ASTM C 1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable.

Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested per ASTM D 882, and a maximum flame spread/smoke developed index of 25/50 per ASTM E 84.

Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for PVDC Film Vapor Retarder in paragraph above.

Non-Vapor Retarder Mastic Coatings

ASTM C 1136, Type III, maximum moisture vapor transmission 0.10 perms, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable.

Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum moisture vapor transmission of 0.02 perms, and a maximum flame spread/smoke developed index of 25/50 per ASTM E 84.

**PART 3 INSULATION SYSTEMS: PIPING**

INSULATION: GENERAL

Install insulation in a neat and workmanlike manner, observing the best practices of the trade. Longitudinal seams shall be flat and face structure away from view. Insulation shall be smooth throughout. No raw ends of insulation will be permitted; cover raw ends with caps.

INSULATION: STEAM SYSTEM PIPING

Service / Insulation System:	Low Pressure Steam	HC
	Low Pressure Condensate	HC

Materials: One piece piping insulation of long, fine, flame attenuated glass fibers, covered with factory applied all purpose jacket of white kraft bonded to aluminum foil and reinforced with fiberglass yarn.

Flame spread:	25
Smoke developed:	50
Conductivity:	.25 at 100 deg mean

Insulation shall be as manufactured by Johns-Manville, Owens Corning, Certain-Teed, or approved equal.

Workmanship: Insulation shall be applied over clean, dry surfaces, with adjoining sections butting firmly together. Flanges, valves, and fittings shall be insulated with fabricated mitered segments of pipe insulation, equal in thickness to the insulation of the adjoining pipe. Fittings on pipe sized 3 inch and

smaller may be insulated with a submitted and approved insulating cement of equal thickness. Insulation and vapor barrier shall pass uninterrupted through all hangers, supports and pipe sleeves.

Thickness: Install insulation thickness as follows:

SCHEDULE OF INSULATION THICKNESS

Type of Piping	Pipe Size (inches)	
	1/2 to 3-1/2	4 and larger
Low pressure	1"	1-1/2"
Return	1"	1-1/2"
Pump discharge	1"	--

Scope: All new supply, return, airloops and pump discharge piping with associated fittings; and all disturbed, damaged existing piping insulation where removal, connections are indicated for the new modified system.

**PART 4 EXECUTION**

**GENERAL:**

**Installation:**

Insulation shall only be applied to non-operating, unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the job site. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

**Fire-Stopping:**

Where pipes and ducts pass through firewalls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials.

**Painting and Finishing:**

Painting shall be as directed by the Owner or to match existing requirements.

**Installation of Flexible Elastomeric Cellular Insulation**

Flexible elastomeric cellular insulation shall be installed with seams and joints sealed with rubberized contact adhesive. Insulation with pre-applied adhesive is not permitted. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 200 degrees F. Seams shall be staggered when applying multiple layers of insulation. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish as recommended by the manufacturer after the adhesive is dry. A brush coating of adhesive shall be applied to both butt ends to be joined and to both slit surfaces to be sealed. The adhesive shall be allowed to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

Pipes which require Insulation:

Insulation is required on all pipes, ducts, or equipment, unless specifically noted otherwise.

### PIPE INSULATION INSTALLATION

General:

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full-length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used.

Pipes Passing Through Walls, Roofs, and Floors

Pipe insulation shall be continuous through the sleeve.

An aluminum jacket with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.

Where pipes penetrate interior walls, the aluminum jacket shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

Where penetrating waterproofed floors, the aluminum jacket shall extend from below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 2 inches beyond the interior surface of the wall.

Where penetrating roofs, pipe shall be insulated as required for interior service to a point flush with the top of the flashing and sealed with vapor retarder coating. The insulation for exterior application shall butt tightly to the top of flashing and interior insulation. The exterior aluminum jacket shall extend 2 inches down beyond the end of the insulation to form a counter flashing. The flashing and counter flashing shall be sealed underneath with caulking.

Pipes Passing Through Hangers:

Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40

protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed.

Horizontal pipes larger than 2 inches at 60 degrees F and above shall be supported on hangers in accordance with MSS SP-69.

Horizontal pipes larger than 2 inches and below 60 degrees F shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass, calcium silicate (or perlite above 80 F) or the necessary strength polyisocyanurate, shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

**END OF SECTION 23 04 00**

**SECTION 23 54 50 – HVAC: STEAM SYSTEMS**

**PART 1 - GENERAL**

**RELATED DOCUMENTS:**

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 and the following listed sections as a minimum, apply fully to work in this section.

Section 230000           MECHANICAL GENERAL REQUIREMENTS

Refer to and coordinate all work with the work of the following listed Sections:

Section 230150	MECHANICAL: VIBRATION ISOLATION
Section 230250	MECHANICAL: PIPE HANGERS AND SUPPORTS
Section 230300	MECHANICAL: FIRE SAFING
Section 230400	MECHANICAL: INSULATION
Section 239000	HVAC: AUTOMATIC CONTROL / DIGITAL
Section 239400	HVAC: SEQUENCE OF OPERATIONS
Section 239500	HVAC: TESTING AND BALANCING

**SCOPE:**

Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.

**RELATED WORK:**

Work in conjunction with this section shall be as designated below:

General Contractor:

Cutting, Patching, and Painting  
Openings in roofs / Flashing  
Openings in walls  
Equipment foundations and bases  
All temporary heating

Electrical Contractor:

Power wiring for electrical equipment provided within this section.

**PROJECT ADMINISTRATION:**

Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Owner / Engineer.

Prepare and transmit to the Owner / Engineer all submittal requirements within the time period allowed. See Schedule of Submissions.

**SUBMITTALS:**

See SUBMITTAL GENERAL REQUIREMENTS within Section 230000.

The following shop drawings shall be prepared (see Section 230000) and submitted for approval within the time period stated: (This listing is not intended to all inclusive – provide submittals for all materials and equipment proposed for use on this project)

- Pipe and Fittings
- Valves, Cocks, Unions
- Piping Specialties
- Gauges and Instrumentation

**PROJECT CLOSE-OUT:**

Review and provide close-out requirements of this section and Section 230000 Mechanical General Requirements, including:

- Testing and Adjusting
- Record Drawings
- Operating, Maintenance Instructions
- Written Guarantee
- Lubrication, Filters
- Operating, Maintenance Manuals
- Cleaning
- Test Log
- Letters of compliance.

**PART 2 - PIPING PRODUCTS AND INSTALLATION**

**PIPING: INSTALLATION, GENERAL:**

Arrange and install piping approximately as indicated, straight, plumb, and as direct as possible. Form right angles or parallel lines with building wall. Keep pipe close to walls, partitions and ceilings. Offset only where necessary to follow walls. Where so indicated and wherever possible, conceal piping in building construction before erection of closing construction. When furred spaces are indicated, keep pipes as close to structural members as possible. Piping shall not interfere with openings, doors and windows. Allow for proper clearance at windows, doors, equipment and other building parts such that pipe does not interfere with access and building use.

Piping shall be cut accurately to measurements established at the site and shall be installed without springing, forcing and excessive cutting or weakening of building structure. Pipes shall be installed in a manner permitting proper drainage, venting and free expansion and contraction. Changes in direction shall be made with factory-manufactured fittings.

Install pipe to allow for expansion without excessive stress on pipe, hangers and building.

Welding, brazing, soldering shall be with proper regard for fire prevention and safety.

Arrange piping passing through floors, walls and other partitions of building construction so that piping is centered in openings/sleeves and is rigidly supported on both sides of openings/sleeves.

Clean pipe, pipe fittings, and valves before erection. Cap or plug open ends of piping and equipment during construction to keep dirt and foreign material out of system.

Before installing, clean black steel pipe and fittings by hammering to loosen scale and rust and flush out with water or blow out with compressed air or high pressure steam under controlled safe conditions.

After threading steel pipe, clean pipe ends carefully to remove cutting oil and metal particles.

Unions or flanges shall be used to facilitate piping installation, and shall be installed between shut-off valves and equipment to facilitate removal of equipment for repair.

Provide dielectric unions where pipes of dissimilar metals are joined together.

Grade steam and condensate return mains at uniform slope of 1" in 40 ft.

Take steam supply branches off top of main, vertically or at 45 degree angle.

Where horizontal steam and steam condensate return piping is reduced in size, use eccentric reducers and arrange so that steam piping is flush on bottom and steam condensate return piping is flush on top.

Provide drip points in steam lines at ends of mains, at points where rise in main elevation is required, and at low points whether indicated on the Drawings or not.

Isolate and drain existing systems as required to complete the Work.

Branch piping connections from mains to fixed equipment and connections from risers to horizontal mains shall have minimum of three (3) 90 degree elbows and be arranged in swing fashion to permit unrestricted expansion and contraction of piping and minimize stress at connections to risers and fixed equipment.

Do not route pipelines over switchboards, panels, motor control centers, individual motor starters and other electrical equipment.

Avoid routing pipelines over electrical raceways and bus ducts. If these locations cannot be avoided, provide drip pans under pipelines. Also provide drip pans where indicated on the Drawings. Drip pans shall be constructed of minimum 22 gauge stainless sheet metal with waterproof mastic applied to interior seams and joints. Pan width shall be minimum 2 times pipe diameter and with sides turned up minimum of 4" high and fitted with hemmed edge. Do not hang drip pans from pipe. Pitch pans minimum 1/8" per foot and provide 3/4" drain connection at low points. Pipe drains to nearest floor drain or as shown on the Drawings.

PIPING: STEAM (2-1/2" and Smaller)

Material: Provide Schedule 40 black steel pipe with 150 psi steel fittings.

Joints: Screw joints with standard pipe thread and approved compound applied to the male threads only.

Workmanship: Ream all pipe to full diameter before joining. Allow for proper pitch and expansion. Install parallel or perpendicular to building construction.

Tests: Refer to SECTION 23 04 40 - MECHANICAL: PIPE CLEANING TESTING for all cleaning and testing methods required.

PIPING: STEAM CONDENSATE RETURN:

Material: Provide Schedule 40 black steel pipe with 150 psi steel fittings.

Joints: Screw joints with standard pipe thread and approved compound applied to the male threads only.

Workmanship: Ream all pipe to full diameter before joining. Allow for proper pitch and expansion. Install parallel or perpendicular to building construction.

Tests: Refer to SECTION 23 04 40 - MECHANICAL: PIPE CLEANING TESTING for all cleaning and testing methods required.

VALVES:

Low Pressure Steam Service:

Non-Rising Stem Type Gate Valves: 1/2" to 2-1/2" bronze 150#, threaded ends.

Milwaukee	1140
Stockham	B-128
Crane	437
Nibco	T-133

O.S.&Y. Type Gate Valves 2" to 12" iron body 125#, flanged ends.

Milwaukee	F-2885
Stockham	G-623
Crane	465 1/2
Nibco	F-617-O

Globe Valves 1/2" to 2" iron body 150#, threaded ends.

Milwaukee	1590-T
Stockham	B-24T
Crane	1342
Nibco	S-413-Y

Steam Condensate; Check Valves: 1/4" to 2" bronze 150#, threaded ends.

Milwaukee	510-T
Stockham	B-322-T
Crane	137-T
Nibco	T-433-Y

Drain Valves:

Drain Valves: 1/4" to 2" cast bronze 600# W.O.G., full port, screwed ends w/ capped hose end, chain and cap.

Milwaukee	BA-1001T
Apollo	78-100

#### VALVE TAGS / CHARTS:

The Mechanical Contractor shall furnish and install on each gate and globe valve and on all automatic control valves installed under this contract a two-inch diameter brass tag with stamped black numerals. The tags shall be attached to the valve handles of stem necks with brass hooks or chains and properly secured.

These numbers shall correspond with numbers indicated for valves and controls on the record drawings and on two printed detail lists. These printed lists shall state the number and locations of each valve and control, and the section, fixture or equipment which it controls and other necessary information such as requiring the opening or closing of another valve where only one valve is to be opened or closed.

These printed lists shall be prepared in a form to meet the approval of the Owner / Engineer and shall be framed under glass. Also, see Section 15000 for Pipe and Equipment Identification.

#### PRESSURE GAUGES:

Provide 4 1/2" dial, geared bourdon tube type pressure gauges with steel case painted with corrosion resistant paint. Provide shut-off cock, and looped pigtail piping at all gauges.

Model: Figure 1188/1220 Ashcroft General Service Gauge.

#### FLOAT & THERMOSTATIC STEAM TRAPS:

Provide where indicated and at all drip points in the steam system an F & T trap of the proper size and capacity. Provide isolation gate valve ahead of each trap.

Traps shall be:

Type FT or Type FTL Sarco or approved equal by Hoffman, Barnes & Jones.

Trap shall be proper for operating pressure of the piping.

#### STRAINERS:

Provide where indicated, in-line strainers of proper size and capacity. Strainers shall be suitable for all pressures to 250 psig.

Strainers shall be of cast iron construction with type 304 stainless steel screen housed within a tapered screen pocket within the strainer body. Strainers shall be such that there is a sediment collection chamber below the screen.

Strainers shall be:

Type IT or Type IF Sarco or approved equal by Hoffman, Barnes & Jones.

**SUPPORTS: PIPE HANGERS:**

General: Provide pipe supports, hangers, or other appurtenance to firmly support the piping systems. All pipes shall be independently supported from the building structure and not from other pipes, flues, conduits, ducts or pipe hangers, etc.

Refer to Section 230250 – MECHANICAL PIPE HANGERS AND SUPPORTS for pipe hanging requirements.

**PART 3 – INSULATION**

**INSULATION: GENERAL:**

Provide all insulation as specified in a neat and workmanlike manner observing the best practices of the trade. All longitudinal seams shall be flat and facing away from view. Insulation shall be smooth throughout. Vapor barriers, where required, shall be continuous. No raw ends of material shall be permitted; cover all end elements with insulating cement or brush on vapor barrier material.

**INSULATION: STEAM PIPING SYSTEMS:**

Steam piping and equipment shall be insulated as specified within Section 230400 – MECHANICAL INSULATION.

**END OF SECTION 23 45 50**

**SECTION 23 85 00 – HVAC EQUIPMENT**

**PART 1 - GENERAL**

**RELATED DOCUMENTS:**

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 and the following listed sections as a minimum, apply fully to work in this section.

Section 230000           MECHANICAL GENERAL REQUIREMENTS

Refer to and coordinate all work with the work of the following listed Sections:

Section 230050           MECHANICAL: ELECTRICAL COMPONENTS  
Section 230150           MECHANICAL: VIBRATION ISOLATION  
Section 230250           MECHANICAL: PIPE HANGERS AND SUPPORTS  
Section 230300           MECHANICAL: FIRE SAFING  
Section 230400           MECHANICAL: INSULATION

Section 235450           HVAC: STEAM SYSTEMS

Section 239000           HVAC: AUTOMATIC CONTROL / DIGITAL  
Section 239400           HVAC: SEQUENCE OF OPERATIONS

**SCOPE:**

Provide labor, equipment and materials to complete the work indicated on drawings and herein specified.

**RELATED WORK:**

Work in conjunction with this section shall be as designated below:

**General Contractor:**

Cutting, Patching, and Painting  
Openings in roofs / Flashing  
Openings in walls

**Electrical Contractor:**

Power wiring for electrical equipment provided within this section.

**PROJECT ADMINISTRATION:**

Transmit questions, submissions, notices, and correspondence through the general contractor for transmittal to the Architect/Engineer.

Prepare and transmit to the Architect/Engineer all submittal requirements within the time period allowed. See Schedule of Submissions.

**SUBMITTALS:**

See SUBMITTAL GENERAL REQUIREMENTS within Section 230000.

The following shop drawings shall be prepared (see Section 230000) and submitted for approval within the time period stated above: (This listing is not intended to all inclusive – provide submittals for all materials and equipment proposed for use on this project)

Unit Ventilators

Supports, frames, vibration isolators for all equipment.

**PROJECT CLOSEOUT:**

Review and provide closeout requirements of this section and Section 15000 Mechanical General Requirements, including:

- Testing and Adjusting
- Record Drawings
- Operating, Maintenance Instructions
- Written Guarantee
- Lubrication
- Filters
- Operating, Maintenance Manuals
- Cleaning
- Test Log
- Letters of compliance.

**PART 2 – EQUIPMENT**

**UNIT VENTILATOR:**

Provide vertical, floor mounted unit ventilator with steam heat as manufactured by Magic Aire (United Electric Company) Fan Coils. Unit shall be factory Direct Digital Controls (DDC) ready to be incorporated into an existing BACNet network. Unit shall meet requirements per the NE-CHPS Guidelines.

Unit shall be tested and certified in accordance with AHRI Standard 840. Unit insulation and adhesive shall meet the requirements for flame spread rating of lower than 25 per ASTM 84 and smoke generation rating lower than 50 per ASTM 84. Only closed cell insulation shall be used. The use of fiberglass insulation shall not be accepted.

Opposite end steam coils (bare) shall be factory leak tested at 350 psig air pressure with coil submerged in water.

Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material. Inspect all units for transit damage. Store and handle materials per Mechanical General Requirements 23 00 00.

Unit shall be a factory-assembled bolt-together unit ventilator. Contained within the unit enclosure shall be factory-installed motor, wiring, blowers, coil, bearing, outdoor/return air damper, optional face/by pass damper and DDC ready. Unit shall have a draw-thru design for uniform air distribution across the coil and even discharge temperatures.

Unit frame shall be 14-gauge galvanized steel components that form a rigid foundation and resist corrosion. Unit composed of three main sub-assembled modules: Blower Module, Coil Module and Damper Module. Modules shall be externally insulated using at least 3/8" closed cell insulation. Unit back shall be insulated using at least 3/8" closed cell insulation. Exterior access panels shall be constructed of heavy gauge galvanized steel 14 gauge material that have been cleaned and pretreated before painting to maximize corrosion resistance. Exterior service access panels shall be retained by tamper-resistant fasteners. Panels are electrostatically coated with polyester powder baked on textured paint,

Unit depth shall be 16-5/8" deep for standard units (21-7/8 for optional extended units), 30-in. tall cabinet with three standard 14-gauge exposed front panels, and service access panels with tamper-resistant hex socket head threaded fasteners and retainer chains for safety and ease of service. Refer to the DRAWINGS for units requiring extended cabinet depth.

Cabinet models shall be at least 14-gauge and charcoal bronze as standard with steel bar-stock discharge grille. Baked powder finish shall be color Polar Ice. External access panels shall be easily removed from outside of the unit for access to filters and routine maintenance. End panel corners shall be welded and ground smooth for appearance and durability. Unit top shall be easily removed for routine maintenance.

Rated 1250 cfm units shall have standard bar-stock steel linear discharge grille, anodized aluminum double deflection discharge grille. Unit shall have two hinged bottom access panels.

Unit Ventilators shall be equipped with end panels if no shelving is provided. A top barstock grill with screens shall be provided.

One row steam coils with right hand supply and left hand return shall be provided. Coils shall be the freeze resistant, double tree, distribution type utilizing a tube-in-tube design with a long life copper header. Provide pre-heat coil arrangement option.

Fans and motor assembly shall be direct driven. Fan wheels shall be statically and dynamically balanced. Fan blower housing shall be constructed with heat-gauge steel and mounted to heavy-gauge galvanized steel fan deck.

To prevent vibration transmission to the unit frame, motor and shaft bearing shall be resiliently mounted. The drive shaft shall be connected to motor with a flexible coupling.

Fan motors shall be mounted outside of the airstream on a heavy-gauge steel partition and removable without removing the blower module. Provide ECM motors, 0-10 VAC controlled. All motors shall have integral high temperature reset and shall be protected with cartridge-type fuses.

Filters: Unit shall be equipped with one piece 1" throwaway filters. Unit shall be capable of holding 2" filters. For even filter loading, filter shall be positioned to filter mixed outdoor and return air. Filter track shall be field adjustable to accept 1" or 2" permanent or renewable media replacement filters.

Dampers: Unit shall contain single outdoor air / return air damper with a continuous seal the length of the damper. The damper shall be constructed of extruded aluminum that has an integral curved web to afford maximum rigidity. External closed cell insulation shall be applied. The damper assembly shall include an anti-draft plate to prohibit outdoor air from penetrating the classrooms through the damper assembly. A single face and bypass damper with continuous seal the length of the damper constructed of extruded aluminum shall be available.

Controls and Safeties: The manufacturer shall furnish, install, wire and factory test a complete control package suitable for the unit type selected. The unit DDC ready (BAC-net) and include Face & Bypass Control with 0-10 VDC Face & By-Pass and OA dampers. Unit shall be capable of economizer mode,

Demand Control Ventilation via interlock with new space Carbon Dioxide Sensor, and ASHRAE Cycle III control.

The minimum position of the outdoor air / return air actuator shall be adjustable by the installing contractor and/or owner/operator.

ASHRAE Cycle III shall be available. Unit shall be capable of accepting a field installed CO2 sensor with factory installed IAQ DDC Control Package. Power shall be 115V single phase electrical. Unit shall include 1-Year Parts Only Warranty.

#### STORAGE CABINET and SHELVING SYSTEMS:

##### General:

Provide fully assembled cabinets as indicated on the Drawings.

##### Base Unit:

Each unit base and side panels shall be constructed of 18-gauge cold-rolled steel. Side panels shall have seven (7) adjustable slots to support shelves and additional 12-gauge steel internal side supports that are welded for additional vertical rigidity. Bottom base is supported by two 14-gauge horizontal continuous angles the length of the cabinet. Two support bases are fabricated from 14-gauge steel and four adjustable feet allowing for a 1-inch vertical adjustment.

One fully adjustable shelf from 16-gauge steel is supported by a 16-gauge continuous welded angle for additional strength. Each cabinet is supplied with front and side adjustable floor kick plates to conceal cabinet legs and a back wall F-channel from 18-gauge steel to support the length of the cabinet and deliver a uniform continuous appearance. All cabinet parts are cleaned and phosphatized prior to applying a baked on polyester powder coat finish.

##### Standard Steel Top:

Cabinet steel tops are assembled to the base cabinet and are fabricated from 16-gauge furniture quality cold-rolled steel and two 16-gauge support channels are welded to the top underside for additional support. Tops are sanded to remove all blemishes prior to being cleaned and phosphatized before applying a baked on polyester powder coat finish.

##### Laminate Top:

Laminate tops are assembled to the base cabinet. Fabricated from 1-inch high quality particleboard with a large variety of colors.

##### Accessories:

End Covers: 1-inch standard end panels can be installed to finish off cabinets when needed. End panels are fabricated from 18-gauge furniture quality cold-rolled steel. Internal 16-gauge steel side stiffeners are welded for additional support. Top corners are sanded to remove all blemishes prior to being cleaned. End panels will be cleaned and phosphatized prior to applying a baked on polyester powder coat finish to match cabinets.

Fill-In Sections:

Filler sections are available in 12-inch, 18-inch and 24-inch wide. Filler sections come with side and top F-channels to hide field cut sections. Filler sections tops are fabricated from 16-gauge furniture quality cold-rolled steel. Filler sections are designed to be cut in the field and include required angels and hardware for a proper installation. Filler sections will be cleaned and phosphatized prior to applying a baked-on polyester powder coat finish to match cabinets.

Corners:

Corner sections are fabricated from 16-gauge furniture quality cold-rolled steel and come with two top F-channels to secure corner to the wall. Corner sections will be cleaned and phosphatized prior to applying a baked on polyester powder coat finish to match cabinets.

Utility Compartments:

Unit shall include pre-assembled utility compartment and galvanized drain pan.

Pre-assembled and free standing with removable front panel. Utility compartments are used to conceal additional piping and valve tops and are fabricated from 16- ga. Furniture quality cold-rolled steel. Utility Compartments will be cleaned and phosphatized prior to applying a baked-on polyester powder coat finish to match cabinets.

Counter Top:

Steel top. Color shall be Polar Ice for top and bottom, coordinate with Owner/Engineer.

**PART 3 – EXECUTION:**

**EQUIPMENT INSTALLATION, GENERAL:**

All equipment shall be installed and connected as indicated on the Drawings and in strict accordance with the manufacturer's recommendations. Sufficient clearance to allow effective maintenance shall be provided and sufficient clearance for electrical parts shall be maintained per the requirements of the National Electric Code.

**EQUIPMENT START AND TEST, GENERAL:**

All equipment should be started and tested by the HVAC Contractor once the installation is complete and prior to the start of system balancing work.

**FACTORY START AND TEST, GENERAL:**

The HVAC Contractor shall schedule manufacturer's start and test work as required such that the work is complete prior to the start of system balancing work. Refer to the individual equipment specifications for manufacturer's start and test requirements.

**END OF SECTION 23 85 00**