DIXIE STATE UNIVERSITY
BURNS ARENA BOILER REPLACEMENT

DFCM PROJECT # 14281640

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT
REVIEWED FOR CODE COMPLIANCE
SIGNATURE:
DATE: 03/10/2015

THE GREAT SEAL OF THE STATE OF UTAH
INDUSTRY
1847
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PROFESSIONAL ENGINEER
02-27-15
WINWARD M. PACKER
NO. 375080
STATE OF UTAH

State of Utah—Department of Administrative Services

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT

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SPECIFICATIONS

Approval Stamp

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FEBRUARY 2015

WHW Engineering Project #14053

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DIVISION 1
GENERAL REQUIREMENTS

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SECTION 01000 - GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 This project shall be a standard DFCM single prime contract. DFCM General Conditions and design and construction standards shall apply.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01000

SECTION 01100 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Work covered by the Contract Documents.
2. Type of the Contract.
3. Owner's occupancy requirements.
4. Work restrictions.
5. Specification formats and conventions.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Dixie State University, Burns Arena Boiler Replacement

1. Project Location: Dixie State University Campus- St. George, Utah

B. Owner: State of Utah DFCM, D.S.U

1. Owner's Representative: Brad Demond

C. Architect: WHW Engineering 8619 S Sandy Parkway #101 Sandy UT 84070.

D. The Work consists of the following:

1. The Work includes:

a. Provide two new high temp heating boilers.
b. Re-configure piping system in boiler room.
c. Upgrade controls for new boilers and existing pumps.
d. Provide electrical modifications and additions as necessary to accommodate project.
e. Remove the existing two boilers and all attached piping, valves, electrical, controls, etc. as indicated on the drawings.

1.4 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

1.5 USE OF PREMISES

A. General: Contractor shall have limited use of premises for construction operations as indicated in project documents.

B. Use of Site: Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy of Project site and use by the public.
2. Driveways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

   a. Schedule deliveries to minimize use of driveways and entrances.
   b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

1.6 OWNER'S OCCUPANCY REQUIREMENTS

A. Full Owner Occupancy: Owner will occupy site and existing building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits, unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.7 WORK RESTRICTIONS

A. On-Site Work Hours: Work shall be generally performed inside the existing building during normal business working hours of 8:00 a.m. to 5:00 p.m., Monday through Friday, except otherwise indicated.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than 72 hours in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's permission.

1.8 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 16-division format and CSI/CSC's "MasterFormat" numbering system.

1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

   a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1.9 MISCELLANEOUS PROVISIONS

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01100

SECTION 01230 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Provide cost to reduce design criteria for the expansion drum to 150#'s in lieu of 300# specified. Flanged connections shall remain at 300 #.

END OF SECTION 01230

SECTION 01524 - CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Disposing of nonhazardous demolition and construction waste.

B. Related Sections include the following:

1. Division 1 Section "Selective Demolition" for disposition of waste resulting from demolition of boilers, piping, electrical, controls, etc. shown on the demolition drawings.

1.3 DEFINITIONS

A. Construction Waste: Mechanical, electrical and control materials and other solid waste resulting from construction. Construction waste includes packaging.

B. Demolition Waste: Building materials resulting from selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction, and requirements of the state regulations agencies.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Owner. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled or reused.
2. Comply with Division 1 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Store items in a secure area until installation.
3. Protect items from damage during transport and storage.
4. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Owner's Use:

1. Clean salvaged items.
2. Store items in a secure area until delivery to Owner.
3. Transport items to Owner's storage area on-site designated by Owner.
4. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.
2. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

    1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
    2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 01524

SECTION 01731 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching, if required for installation, repair of damaged surfaces or replacing areas that were renovated.

B. Related Sections include the following:

1. Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on

the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.5 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed or relocated, bypass such services/systems before cutting to minimize interruption to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
5. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.

2. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and

appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, grout, dust and similar materials.

END OF SECTION 01731

SECTION 01732 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected items shown on the drawings.
2. Demolition and removal of selected equipment.
3. Salvage of existing items to be reused or recycled.

B. Related Sections include the following:

1. Division 1 Section "Summary" for use of premises, and phasing, and Owner-occupancy requirements.
2. Division 1 Section "Construction Waste Management" for disposal of demolished materials.
3. Division 1 Section "Cutting and Patching" for cutting and patching procedures.

1.3 DEFINITIONS

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

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

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

D. 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.

1.4 SUBMITTALS

A. Qualification Data: For demolition firm.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted before shutdown.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Locations of proposed dust- and noise-control temporary partitions and means of egress.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
6. Means of protection for items to remain and items in path of waste removal from building.

C. Pre-demolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations.

D. Contractor shall contact engineer if questions about items to be removed and items to remain are not clear. Do NOT remove items until engineer has answered contractor's questions. If items are removed that should have remained, contractor shall install new items or re-install existing if not damaged during demolition, without cost to owner.

1.5 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

1.6 PROJECT CONDITIONS

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

1. Comply with requirements specified in Division 1 Section "Summary."

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical. Owner will remove all storage materials deemed necessary by contractor in order for contractor to do his work.

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

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

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

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

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

1.7 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that existing utilities above and below floor have been located and protected.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Engineer.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

1. Comply with requirements for existing services/systems interruptions specified in Division 1 Section "Summary."

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.

2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3.3 PREPARATION

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

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

1. Provide protection to ensure safe passage of people around selective demolition area and to and from exits.
2. Provide temporary protection, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect equipment, pumps, etc. that will remain.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
2. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
3. Maintain adequate ventilation when using cutting torches.
4. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
5. Dispose of demolished items and materials promptly. Comply with requirements in Division 1 Section "Construction Waste Management."

B. Removed and Salvaged Items: Coordinate with DSU.

1. Clean salvaged items.
2. Store items in a secure area until delivery to Owner.
3. Transport items to Owner's storage area on-site.
4. Protect items from damage during transport and storage.

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Comply with requirements specified in Division 1 Section "Construction Waste Management."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

A. 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 01732

SECTION 01770 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Warranties.
3. Final cleaning.

B. Related Sections include the following:

1. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
2. Divisions 2 through 16 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Complete startup testing of systems.

8. Submit test/adjust/balance records.
9. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
10. Complete final cleaning requirements, including touchup painting.
11. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to General Conditions.
2. Submit certified copy of Engineer’s Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 WARRANTIES

A. Submittal Time: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

END OF SECTION 01770

SECTION 01781 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Product Data.

B. Related Sections include the following:

1. Division 1 Section "Closeout Procedures" for general closeout procedures.
2. Division 15 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Divisions 2 through 16 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set of marked-up Record Prints.

B. Record Product Data: See section 15010 for O&M requirements.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained

record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an understandable drawing technique.
c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Revisions to routing of piping and conduits.
d. Revisions to electrical circuitry.
e. Actual equipment locations.
f. Breeching routing.
g. Changes made by Change Order or Change Directive.
h. Changes made following Engineer's written orders.
i. Details not on the original Contract Drawings.
j. Field records for variable conditions.
k. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings completely and accurately.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

2.2 RECORD PRODUCT DATA

A. See section 15010 for O&M requirements.

2.3 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

END OF SECTION 01781

SECTION 01782 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Operation manuals for systems, subsystems, and equipment.
3. Maintenance manuals for the care and maintenance of products, systems and equipment.

B. Related Sections include the following:

1. Division 1 Section "Closeout Procedures" for submitting operation and maintenance manuals.
2. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
3. Divisions 2 through 16 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

A. Final Submittal: Submit 3 copies of each manual in final form at least 7 days before final inspection. Engineer will return copy with comments within 15 days after final inspection.

1. Correct or modify each manual to comply with Engineer's comments. Submit 3 hard copies of corrected manual and 3 electronic copy in a pdf format within 15 days of receipt of Engineer’s comments.

1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE MANUALS

A. See section 15010 for O&M Manual requirements.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

C. Comply with Division 1 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01782

DIVISION 15
MECHANICAL

15010 GENERAL REQUIREMENTS
15050 BASIC MATERIALS & METHODS
15062 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
15074 VIBRATION AND SEISMIC CONTROLS FOR HVAC
15077 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
15083 HVAC INSULATION
15112 GENERAL-DUTY VALVES FOR HVAC PIPING
15127 METERS AND GAUGES FOR HVAC PIPING
15181 HYDRONIC PIPING
15195 FACILITY NATURAL-GAS PIPING
15515 WATER-TUBE BOILERS
15550 BREECHINGS, CHIMNEYS, AND STACKS
15900 FACILITY MANAGEMENT AND CONTROLS SYSTEM
15940 SEQUENCE OF OPERATION
15950 TESTING, ADJUSTING AND BALANCING

SECTION 15010 - GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

A. General Conditions and Division 01 apply to this Division.

1.2 SCOPE

A. Includes -

1. Furnish all labor, materials, and equipment necessary for the completion of the mechanical scope of work shown on the drawings and noted in section 01100 “Summary”
2. Furnish and install all motors specified in this Division and be responsible for the proper operation of electrical powered equipment furnished by this Division.
3. Furnish exact location of electrical connections and information on motor controls to electrical design build contractor.
4. Mechanical Contractor shall obtain the services of independent Test and Balance Agency.
5. Placing the new boilers, and hot water systems into full operation and continuing their operation during each working day of testing and balancing.
6. Water balance, final adjustment and test run.
7. The satisfactory performance of the completed systems is a requirement of this specification.

B. Related Work Specified Elsewhere

1. Conduit, line voltage wiring, outlets, and disconnect switches specified in Division 16.
2. Magnetic starters and thermal protective devices (heaters) not a factory mounted integral part of packaged equipment are specified in Division 16.

1.3 SITE OBSERVATION

A. The Contractor shall examine the site and understand the conditions which may affect the performance of work of this Division before submitting proposals for this work.

B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine existing site conditions.

1.4 DRAWINGS

A. Mechanical drawings show general arrangement of boilers piping, breeching, equipment, etc; however, locations are to be regarded as shown diagrammatically only. Follow as closely as actual building construction and work of other trades will permit.

B. Because of the small scale of mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. Investigate existing structural and finished conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
If changes in location of piping, equipment, breeching, etc. are required due to lack of coordination of work under this division, such changes shall be made without charge.
It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for the installation of systems according to the true intent and meaning of the Contract Documents. Anything not clear or in conflict will be explained by making application to the Engineer in writing. Should conditions arise where certain changes would be advisable, secure Owner's and Engineer approval for these changes before proceeding with work. The height and length of equipment is very critical for this project.

1.5 COORDINATION OF WORK:

A. Coordinate work of various trades in installing interrelated work. Before installation of mechanical items, make proper provision to avoid interferences. Changes required in work specified in Division 15 caused by neglect shall be made at no cost to Owner.

B. Arrange boilers, piping, breeching, and equipment to permit ready access to valves, unions, starters, motors, control components, and to clear openings of doors and access panels.

C. Be responsible for required cutting, and patching incident to work of this Division and make required repairs afterwards to satisfaction of Owner and Engineer. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses.

1. Patch and repair walls, and floors with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
2. This Division shall bear expense of cutting, patching, repairing, and replacing of work of other Divisions because of its fault, error, tardiness, or because of damage done by it.

D. Adjust locations of piping, breeching, equipment, etc, to accommodate work from interferences anticipated and encountered. Determine exact route and location of each pipe and cut prior to fabrication.

1. Make offsets, transitions, and changes in direction of piping, breeching, and electrical raceways as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.

E. This Contractor shall schedule his work, store his equipment and materials, and work in harmony with other Contractors so as to not delay or jeopardize the construction.

F. This Division shall coordinate with design build electrical contractor to insure that all required components of electrical and control work are included and fully understood. Any discrepancies shall be called to the attention of the Engineer before completion of bids. No additional cost shall accrue to the Owner as a result of lack of such coordination.

1.6 EQUIPMENT & MATERIALS:

A. Requests for substitution shall be received in writing a minimum of seven days prior to bidding. Prior acceptance shall be by Manufacturer's name only. Items not listed in this specification or subsequent addendums shall not be considered. No oral approvals will be acceptable. Manufacturers listed in this specification are acceptable only for items listed. All other items manufacturer wishes to bid must be prior approved. All equipment shall be subject to final review in accordance with "Project Submittals".

B. Product Approvals -

1. If approval is received to use other than specified items, responsibility for specified capacities and insuring that items to be furnished will fit space available lies with this Division.

2. In the event other than specified equipment is used and will not fit job site conditions, this Division assumes responsibility for replacement with items named in Specification.

C. Use domestic made pipe, pipe fittings, and motors on Project.

D. Motor and equipment name plates as well as applicable UL labels shall be in place when Project is turned over to Owner.

E. Insure that items to be furnished fit spaces available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. Do not scale off drawings.

F. All materials shall be of the best commercial quality obtainable, consistent with specified materials and for the purpose or function intended. Materials shall be new unless specifically excepted.

G. Equipment catalog or model numbers shown define the basic equipment types and quality standard only. Catalog numbers shall not be considered as all inclusive and shall be verified to include all devices, controls, operators, and appurtenances necessary for the satisfactory and complete operation of the equipment.

H. Follow manufacturer's directions in delivery, storage, protection, and installation of equipment and materials.

1. Promptly notify Engineer in writing of conflicts between requirements of Contract Documents and Manufacturer's directions and obtain Engineer's written instructions before proceeding with work. Contractor shall bear all expenses arising from correcting deficiencies of work that does not comply with Manufacturer's directions or such written instructions.

I. Deliver equipment and material to site and tightly cover and protect against dirt, water, and chemical or mechanical injury but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in a dry, heated space.

1.7 PROJECT SUBMITTALS:

A. Furnish complete catalog data for manufactured items of equipment to be used in the Work to for review within 15 days after award of Contract.

B. Submittal shall include, but not be limited to the following:

1. equipment scheduled
2. balancing contractor
3. insulation
4. automatic temperature controls
5. certificates of guarantee
6. valves
7. any item for which more than one manufacturer is mentioned

C. Submit a minimum of five copies of data in binders and index in same order and name as they appear in Specification. - Optional: Provide electronic submittals. Electronic submittals shall be in .pdf format, and shall be compiled into a single file, with bookmarks for each piece of equipment.

1. State sizes, capacities, brand names, motor HP, electrical requirements, accessories, materials, gauges, dimensions, and other pertinent information.
2. List on catalog covers page numbers of submitted items.
3. Underline or highlight applicable data.

D. If material or equipment is not as specified or submittal is not complete, it will be rejected.

E. Catalog data or shop drawings for equipment which are noted as approved shall not supersede Contract Documents.

F. Review comments shall not relieve this Division from responsibility for deviations from Contract Documents unless attention has been called to such deviations in writing at time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.

G. Check work described by catalog data with Contract Documents for deviations and errors.

H. All items other than first named specified equipment shall show and state all exceptions and deviations taken and shall include design calculations and drawing layouts.

I. The Contractor shall review the submittals prior to submission to make sure that the submittals are complete in all details. No submittal will be reviewed which does not bear the contractor's notation that such checking has been made.

J. No partial submittals will be considered unless approved by the Engineer.

K. Manufacturers' names shall be mentioned as acceptable prior to bidding.

L. Contractor shall verify equipment dimensions to fit the spaces provided with sufficient clearance for servicing the equipment. **This is critical for the boiler size.**

M. Contractor shall review equipment submittals for compliance with schedules, specifications, and drawing plans and details. Equipment submittal shall show the proper arrangements to suit installation and maintenance such as motor location, access doors, piping connections, etc.

N. Equipment submittal sheets shall be clearly marked indicating equipment symbol and exact selection of proposed equipment. Submittals shall clearly indicate name of manufacturer of each item.

O. For unacceptable items, the right shall be reserved to require the first named specified items.

P. Where submittals are sent with any of the above listed information missing or are incomplete they will be returned to the contractor unchecked to be completed and resubmitted. No additional time or money shall be allowed for failure to provide complete submittals on the first review.

Q. If an item requiring submittal review is ordered, purchased, shipped, or installed prior to the submittal review the item shall be removed from the job site and replaced with an approved item at contractors expense.

1.8 CLEANING & FINISHING:

A. Contractor shall, at all times, keep the premises free from waste material and rubbish. Upon completion of this Section of the work, Contractor shall remove all surplus materials and rubbish; clean all spots resulting from the mechanical work from hardware, floors, glass, walls, etc.; do all required patching up and repair all work of other trades damaged by Contractor under this Section of the work, and leave the premises in a clean orderly condition. Remove rust, dirt, grease and oil before painting, insulating, or exposing to view the equipment, piping, breeching, etc. in

completed structure. Refinish any damaged surfaces and leave in proper working order at final completion.

1.9 EQUIPMENT SERVICING:

A. Prior to starting mechanical equipment, all motors, bearings and moving parts shall be properly oiled, greased and lubricated as required. Full and adequate maintenance service shall be given and upon completion all equipment shall be cleaned and checked and placed in perfect condition for the Owner.

B. Amount and type of lubricant shall be per manufacturer's specification.

1.10 SUPERVISION:

A. The Contractor shall supervise and direct the work with his best skill and attention. He will be solely responsible for the means, methods, techniques, sequences and procedures of construction. The Contractor will be responsible to see that the finished work complies accurately with the Contract Documents.

1.11 SAFETY REGULATIONS:

A. Contractor shall provide equipment, supervision, construction, procedures, and everything necessary to assure safety of life or property.

B. Refer also to General Condition and Special Conditions for protection clauses.

1.12 LEAK DAMAGE:

A. Contractor shall be responsible for damages to the work of other Contractors or to the building, or to its contents, people, etc., caused by leaks in any of the equipment or piping installed by him through equipment or material failures, leaking joints or disconnected pipes, fittings, or by overflows and shall make at his own expense all repairs to fixtures, building interior, contents, paint and equipment so damaged.

1.13 TOOLS AND STORAGE OF EQUIPMENT:

A. The Contractor shall furnish all necessary tools, staging and whatever may be necessary for the installation of this work and shall at all times protect this work and

others, and the materials to be used therein from damage by the weather, accident and other causes, and shall repair and make good any damage thus occurring.

1.14 WORKMANSHIP:

A. Workmanship shall be the best quality of its kind for respective industries, trades, crafts and practices and shall be acceptable in every respect to the Owner and Engineer. Nothing contained herein shall relieve the Contractor from performing good work, perfect in all details of construction.

1.15 PAINTING BY CONTRACTOR:

A. Painting shall be by persons experienced in painting.

B. The existing boiler concrete pads, bare piping, equipment, metal stands and supports shall be painted as follows:

1. The prime coat on equipment shall be factory applied. Finish coats shall be field applied.
2. All equipment which is to be furnished in finished painted condition by Contractor shall be left without mark, scratch or impairment to finish upon completion and acceptance of job. Any necessary refinishing to match original shall be done by Contractor. Do not paint over name plates, serial numbers or other identifying marks.
3. Paint colors shall conform to color code requirements as specified in 15077 "Identification of Piping and Equipment".

1.16 EQUIPMENT BASES:

A. After removal of existing boilers, contractor shall clean, patch and paint existing boiler pads.

1.17 ELECTRICAL WORK:

A. Power wiring to all electrically driven apparatus shall be done under the design build electrical contractor. See Electrical Specifications.

B. Unless specifically noted otherwise on documents, design build Electrical Contractor shall furnish and install all magnetic starters including properly sized heaters, and disconnect switches as indicated on drawings or required by code. Coordinate with boiler manufacturer.

C. The Contractor shall verify the proper operation of equipment furnished by him. Costs for repair, replacing, re-wiring and retesting shall be borne by the Contractor without additional costs to the Owner.

1.18 INSPECTION NOTICE:

A. The following is a basic list of guideline items so that the Engineer, building inspector/Owner's representative can be at job site for these inspections as the work progresses. Mechanical Contractor shall inform these people one week in advance of test time.

1. Pressure tests on hot water supply and return piping.
2. The initial start-up of mechanical equipment, etc.
3. Any changes or problems occurring at job site.
4. Periodic inspection at their discretion will be made to insure compliance to Contract Documents and codes. Contractor shall provide ladders, access and other assistance as requested during inspections.
5. Final inspection before giving approval for final payment.

1.19 WARRANTY GUARANTEE:

A. The Contractor shall warrant all materials and equipment to be of quality consistent with specifications as represented by manufacturer's published data.

B. The Contractor shall guarantee that the installation and operation of the equipment shall be free from defects for a period of one year beginning at date of substantial completion and acceptance. The Contractor shall replace or repair any part of the installation that is found to be defective or incomplete within the guarantee period.

C. The guarantee or warrantee specified on equipment and systems shall commence when equipment has been demonstrated to work and has been accepted. (Example: If an equipment item fails to perform and it takes 9 months after substantial completion to correct, then the guarantee shall commence after the item has been demonstrated to perform and has been accepted.)

D. Substantial completion and acceptance in no way relieves the Contractor from providing the systems and equipment as specified.

1.20 COMPLETION SCHEDULE:

A. Start-up and verification of basic equipment items shall be done prior to the date of substantial completion with sufficient time to allow balancing and adjusting to be performed.

B. At the time of the final inspection a date shall be agreed upon for completion of any remaining items.

1.21 CODE REQUIREMENTS, FEES, AND PERMITS

A. The work shall be installed in accordance with the following applicable codes, ordinances and standards unless otherwise specified. The codes and standards shall include but not be limited to and be of the latest and current editions.

1. American Boiler and Affiliated Industries (AB and AI)
2. American Gas Association (AGA)
3. American National Standards Institute (ANSI)
4. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) - ASHRAE 90.1-2007
5. American Society of Mechanical Engineers (ASME)
6. American Society of Testing Materials (ASTM)
7. American Standards Association (ASA)
8. American Welding Society (AWS)
9. Associated Air Balance Council (AABC)
10. Heat Exchange Institute (HEI)
11. Hydraulic Institute (HI)
12. BR
13. National Electrical Code (NEC)
14. National Fire Protection Association (NFPA)
15. Underwriters Laboratories (UL)
16. International Building Code (IBC) 2012 Ed
17. International Mechanical Code (IMC) 2012 Ed
18. International Plumbing Code (IPC) with Utah Amendments 2012 Ed
19. International Energy Conservation Code (IECC) 2009 Ed
20. Utah State Safety Orders (OSHA/UOSH)
21. Utah Fire Rating Bureau
22. Utah Boiler and Pressure Vessel Law/ State Boiler Inspector.
23. Utah Air Conservation Regulations/Waste Disposal regulations.

B. Should drawings conflict with any code, the code shall govern. If drawings and specifications establish a quality exceeding the code, the drawings and specifications shall govern. If conflicts do exist among the drawings, specifications and codes, the same shall be brought to the attention of the Engineer in writing prior to bidding, otherwise Contractor shall comply with applicable codes.

C. The latest edition of all codes shall be used.

1.22 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS

A. Upon completion of work and before final payment, Contractor shall furnish and deliver to the Owner, through the Engineer, installation, operation and maintenance manuals

with instructions for all new materials and equipment used in the building. The contractor shall provide three (3) hard copies of the manuals, and three (3) CD's with electronic copies of the manuals. Electronic information shall be .PDF format. The CD's shall include the same information as the hard copies, and shall be organized in the same manner with electronic bookmarks for each section. CD case and the CD itself shall be labeled the same as the hard copies of the manuals.

B. Bind Operation and Maintenance Manual for Mechanical Systems in a hard-backed piano hinge loose-leaf binder with strong sturdy cover. The project name shall be on the spine and the front of the binder. The front of the binder shall include the following information:

OPERATION
AND
MAINTENANCE
MANUAL
for MECHANICAL SYSTEMS of
(Name of Project)
(Location of Project)
(Date of Project Award)
(Name of Engineer)

C. Introduction

1. Title page including name of project, project number, date awarded and date of substantial completion.
2. Second page shall contain the names, phone numbers and addresses of Engineers, Mechanical Contractor, and Electrical Design Build Contractor.
3. Third page shall include a Table of Contents for the entire manual.

D. First Section - Summary information including:

1. First page shall contain the contractor's warranties.
2. Second page shall contain a list of names, addresses and phone numbers of contractors and all sub-contractors and work to which each was assigned.
3. Final page or pages shall contain an equipment list. The list shall contain each item of equipment or material for which a submittal was required giving ID or tag no as contained on the drawings make and model No. Serial No. Identification No. function along with the name, address, and phone number of the supplier.

E. Second Section - Mechanical Equipment O&M data including:

1. Mechanical maintenance schedule, including a lubrication list when necessary.
2. Mechanical Equipment Operation and Maintenance Data including:

   a. Equipment descriptions

b. Detailed installation instruction, operating and maintenance instructions. Instructions include in a step by step manner identifying start-up, operating, shutdown and emergency action sequence sufficiently clear so a person unfamiliar with the equipment could perform its operations.
c. Equipment drawings, performance curves, operating characteristics, etc.
d. Name addresses and phone number of manufacturer, fabricator and local vender clearly printed or stamped on cover.
e. Complete parts listing which include catalog number, serial number, contract number or other accurate provision for ordering replacement and spare parts.
f. Certified drawings, where applicable, showing assembly of parts and general dimensions.

3. Approved Mechanical submittals

F. Third Section - Controls O&M data including:

1. Sequence of Operation
2. Description of each piece of control equipment and devices. Provide a single line diagram. Describe all alarms and cautions for operation.
3. Provide schematic control diagrams, wiring diagrams, etc. for hot water system, pumps, boilers etc. Control diagram shall show a schematic representation of mechanical equipment and location of start-stop switches, thermometers, pressure gauges, automatic valves, etc. The correct reading for each control instrument shall be marked on the diagram.

G. The Forth Section shall contain a complete water test and balance report. The report shall contain the name, address and phone number of the agency. It shall also include:

1. Data sheets showing amount of water at each setting. See sections 15950.
2. List of testing equipment with date of last calibration.

H. See the following checklist for assistance in assembling manual:

Item #	Description	Y, N, or NA
1.	3 ring heavy duty binder with Project name, number and date on cover and project name on spine.	
2.	O&M manual on CD (with label on CD matching label on manual). Electronic copy shall be a PDF file with bookmarks that match the tabs in the hard copy.	
3.	Title Page including project name, number, address, date awarded, date of substantial completion	
4.	Second Page Contact List including mechanical engineer, electrical design build contractor, mechanical contractor, and controls contractor	

5.	Table of Contents	
6.	**Section 1 - Summary**	
A.	Warranty	
B.	Mechanical's Sub-contractor List	
C.	Vendor List	
D.	Equipment List	
7.	**Section 2 – Mechanical Equipment**	
A.	Maintenance Schedule (including lubrication list)	
B.	Mechanical Equipment O&M Data (for each piece of equipment submitted) per specifications	
C.	Approved mechanical submittals	
8.	**Section 3 - Controls**	
A.	Sequence of Operation	
B.	Controls diagrams	
C.	Controls Equipment	
9.	**Section 4 – Test and Balance Report**	
A.	Complete Test and Balance Report per specifications	

I. See electrical O&M specifications for submittal.

1.23 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Contractor shall instruct building maintenance personnel in the operation and maintenance of the installed mechanical systems utilizing the Operation and Maintenance Manual when so doing.

B. Minimum instruction periods shall be as follows -

1. Mechanical - Eight hours. (See boiler training section 15515)
2. Automation Control - Eight hours.

C. Instruction periods shall occur before final site observation when systems are properly working and before final payment is made.

D. None of these instructional periods shall overlap each other.

E. An additional four hours of instruction will be provided by each contractor, after 60 days of system operation by owner to insure proper system operation and answer questions.

1.24 RECORD DRAWINGS

A. Contractor shall keep an up-to-date set of mechanical drawings in his custody showing all changes in red, clearly defined and neatly drafted by him. At the end of construction, he shall turn these drawings over to the Engineer. Record drawings must be completed and submitted prior to final site observation. See section 01770 closeout procedures.

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PART 2 - PRODUCTS
(Not Used)

PART 3 - EXECUTION
(Not Used)

END OF SECTION 15010

SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical demolition.
4. Equipment installation requirements common to equipment sections.

1.3 DEFINITIONS

A. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

B. All materials, piping, etc. shall be new, and domestically made of the best commercial quality obtainable, consistent with specified materials and for the purpose or function intended unless specifically approved in writing prior to bid.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 COORDINATION

A. Coordinate with boiler manufacture for all insulation requirements and installation manuals.

B. Coordinate installation of required supporting devices.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 150, cast-iron flanges.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 200 deg F.

1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.
h. Prior Approved Equal.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

A. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material until new connection.
2. Equipment to Be Removed: Disconnect and cap services and remove equipment.
3. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
4. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Drawings do not show every offset, or bend that may be required. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping at right angles and parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections. Bending of piping to form elbows is not allowed.

H. Install piping to allow application of insulation.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Verify final equipment locations for roughing-in.

K. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and as shown on the drawings.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment, and as shown on the drawings.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.

D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION 15050

SECTION 15062 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for HVAC system piping and equipment:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Fastener systems.
4. Pipe stands.
5. Equipment supports.

B. Related Sections include the following:

1. Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.3, "Structural Welding Code--Sheet Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. B-Line Systems, Inc.; a division of Cooper Industries.
3. Unistrut.
4. Tolco Inc.
5. Prior approved equal.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.
7. Prior approved equal.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

D. For Clevis Hangers: Insert and shield shall cover lower 180 degrees of pipe.

2.4 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support ground-mounted piping. See detail on drawings.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes. See details on drawings.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.

F. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

G. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
7. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

H. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, and attachments as required to properly support piping from building structure.

B. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

C. Pipe Stand Installation:

1. Pipe Stand Type: Assemble components and mount on concrete floor or pads. See detail on drawings.

D. Install hangers and supports complete with necessary bolts, rods, nuts, washers, and other accessories.

E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement.

F. Install lateral bracing with pipe hangers and supports if required to prevent swaying.

G. Install building attachments to structural steel joists or beams. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping.

H. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

J. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 15062

SECTION 15074 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Freestanding and restrained spring isolators.
3. Seismic snubbers.
4. Restraining braces and cables.

1.3 SCOPE

A. Provide letter of design intent.

B. Provide full set of seismic submittals.

C. Provide a minimum of 2 on site observations.

D. Provide final letter of compliance completion.

1.4 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class: As defined in the IBC.
2. Assigned Seismic Use Group or Building Category: As defined in the IBC.

    a. Component Importance Factor: 1.0.

1.6 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Letter of Design intent, stating company, design criteria, compliance with specifications and only exceptions that will apply. Letter shall be stamped and signed by a licensed and qualified professional engineer in this jurisdiction.

C. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic required to select vibration isolators and seismic.
2. Seismic- Restraint Details:

   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing's. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

D. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

E. Welding certificates.

F. Qualification Data: For professional engineer and testing agency.

G. Field quality-control test reports.

1.7 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

D. Provide a minimum of 2 site observations, and additional observations if required.

E. Upon project completion provide a final letter of acceptance for seismic restraints system and installation.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. Vibro-acoustics.
3. ISAT
4. Mason Industries.
5. Prior approved equal.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene or rubber.

2.2 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. Hilti, Inc.
3. ISAT
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibro-acoustics.
7. Unistrut; Tyco International, Ltd.
8. Prior approved equal.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

D. Restraint Cables: -steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

H. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

I. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid

mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.

B. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling.

2. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
3. Set anchors to manufacturer's recommended torque, using a torque wrench.
4. Install zinc-coated steel anchors for interior.

3.4 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 15074

SECTION 15077 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment: (by Equipment Manufacturer) Use manufacturer's typical metal equipment label or use the flowing.

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Not acceptable.
6. Equipment: New boilers.

B. Plastic Labels for Equipment: (by Contractor)

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 250 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Not acceptable.

C. Label Content: Include equipment's Drawing designation ie. B-1, BTUH, GPM, HP

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing, to fully cover the circumference of the pipe. Pipe labels shall be able to bond on the PVC covering of Pipe.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

D. Stencils are not acceptable.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Permanently fasten labels to boilers.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Piping shall be covered with a PVC colored covering over the insulation. Match label color with that of the covering. Existing piping shall also receive the color PVC jacketing.

B. Locate pipe labels on all piping in the existing boiler room:

1. Near each valve.
2. Near each branch connection
3. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

C. Color code and PVC jacket color

1. HW Supply and Return Lines:

   a. Ironclad - Red
   b. Impervo - PR-31

2. Natural Gas Piping

   a. Match existing

3. Electrical Conduits & Communication Lines:

   a. Impervo - Sun yellow - #133-12

4. All drain and Pressure Relief Lines:

   a. Impervo - Gypsy Gold
   b. 134-3B

5. Chemical Feed Equipment Lines:

   a. Impervo - purple

6. Concrete Pads: (Existing Boilers)

   a. Indust. battleship gray
   b. Moore #75

7. Boiler:

a. Iron Clad white
b. Moore color #01.

8. Metal Stands/ Supports:

a. Industrial battleship grey.
b. Moore color #75.

9. Valves, Valve Bolts, Anchor Bolts, Etc.

a. Spray Paint, Dem Kote, Chrome Silver
b. 6MT45

10. Damaged existing floors.

a. Clean surfaces of all dust, debris etc. before applying sealant. Follow manufacturer's instructions for surface preparation.
b. Seal existing damaged floor with super seal 2000, gloss wet look, acrylic sealer. Follow manufacturer's instructions on sealer installation. Manufacturer of sealer is Concrete Coatings Layton, Utah. 1.800.443.2871

D. Use zinc chrome primer on all galvanized aluminum metal surfaces before painting.

E. Spray Paints

1. Dem-Kote

a. Gloss Red - 06MT45
b. Gloss White - 06MT54
c. Blue Gray - 06MT50
d. Flat Black - 06MT52
e. Gloss Black - 06MT51
f. Gray Primer - 5FW87
g. Chrome Silver - 06MT43
h. Fluorescent Red - 2W011B

2. Rust-Oleum

a. High Temp. Flat Black - V2176
b. High Temp. Aluminum - V2116

END OF SECTION 15077

SECTION 15083 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Insulation of new piping and color coded PVC jacketing on new and existing piping in boiler room.

1. Insulation Materials:

   a. Calcium silicate.
   b. Mineral fiber.

2. Insulating cements.
3. Adhesives.
4. Field-applied jackets.
5. Tapes.
6. Securements.
7. Corner angles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Qualification Data: For qualified Installer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

C. Dixie State University is very particular on piping insulation. If insulation is not installed per these specifications and their standards it will be removed and replaced at contractor's expense.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Store insulation, adhesives, and materials in warm, dry area. Do not expose to moisture or the weather.

1.6 COORDINATION

A. Coordinate size and location of supports, saddles, and that specified in Division 15 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Pipe hangers shall be on outside of insulation. No exceptions.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing of the piping systems and, where required. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Micro-Lok.
b. Owens Corning; Fiberglas Pipe Insulation.
c. Knauf Insulation; 1000 Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Prior approved equal.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A.

A. Calcium Silicate: (For breeching, and FGR piping only)

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Industrial Insulation Group (The); Thermo-12 Gold.
b. Prior approved equal.

2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Insulco, Division of MFS, Inc.; Triple I.
b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
c. Prior approved equal.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

f. Prior approved equal.

C. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-97.
b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
c. Marathon Industries, Inc.; 290.
d. Mon-Eco Industries, Inc.; 22-30.
e. Vimasco Corporation; 760.
f. Prior approved equal.

D. PVC Jacket Adhesive: Compatible with pre-colored PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Red Devil, Inc.; Celulon Ultra Clear.
e. Speedline Corporation; Speedline Vinyl Adhesive.
f. Prior approved equal.

2.4 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.5 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated. All insulated piping new and existing shall have PVC color coded jacketing.

B. Pre colored PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules. Provided by manufacturer installed by contractor.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.

d. Speedline Corporation; SmokeSafe.
e. Prior approved equal.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color-code jackets based on system. Color as selected by Dixie State University. See section 15077 Identification for Piping and Equipment.
4. Factory-fabricated fitting covers to match jacket.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps.

C. Metal Jacket: (For new and existing boiler breeching and, FGR piping)

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; Metal Jacketing Systems.
b. PABCO Metals Corporation; Surefit.
c. RPR Products, Inc.; Insul-Mate.
d. Prior approved equal.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
d. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) End caps.
4) Beveled collars.
5) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.6 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
e. Prior approved equal.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: Vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. Venture Tape; 1506 CW NS.
e. Prior approved equal.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.7 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.
d. Prior approved equal.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide.

2.8 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. Color-coded to match adjacent surface.

B. Aluminum corner angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B209, Alloy 3003, 3005, 3105 or 5005; Temper H14.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Mix insulating cements with clean potable water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top when looking up and bottom when looking down of horizontal runs.

E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

J. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

4. Cover joints and seams with tape as recommended by insulation material manufacturer.

K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

N. For above ambient services, do not install insulation to the following:

1. Nameplates and data plates.

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Flanges, and Unions:

1. Install insulation over fittings, valves, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap

adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
6. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

C. Install removable insulation covers at the areas noted below. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.5 CALCIUM SILICATE INSULATION INSTALLATION (NEW BREECHING AND FGR PIPING.)

A. Insulation Installation on Breeching and FGR piping:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

3.6 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Piping System insulation:

1. Hydronic Piping - per chart.

2. Breeching- Calsium Silicate- 4”

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Minimum Pipe Insulation Thickness from 2009 IECC.

TABLE 503.2.8

MINIMUM PIPE INSULATION

(thickness in inches)

	NOMINAL PIPE DIAMETER	
FLUID	< 1.5”	>1.5”
HEATING HOT WATER	1 ½”	3”
BREECHING		4”

B. For SI: 1 inch= 25.4 mm.

1. Based on insulation having a conductivity (*k*) not exceeding 0.27 Btu per inch/h-ft² - °F.
2. For insulation with thermal conductivity not equal to 0.27 Btu per inch/h- ft² - °F. at a mean temperature of 75° F, the minimum required pipe thickness is adjusted using the following equation: $T= r[(1+t/r)^{K/k}-1]$

   Where:

   T= Adjusted insulation thickness (*in*.)
   r= Actual pipe radius (*in*.)
   t= Insulation thickness from applicable cell in table (*in*.)
   K= New thermal conductivity at 75° F (*Btu-in/hr ft² - °F*)
   K= 0.27 Btu- in/hr-ft² - °F

3.10 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:

1. PVC: 20 mils thick PVC, Pre-Colored Jacket.

D. Provide smooth aluminum jacket over new and existing breeching and FGR piping.

END OF SECTION 15083

SECTION 15112 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following general-duty valves:

1. Copper-alloy ball valves.
2. Ferrous-alloy ball valves.
3. Chainwheel actuators.

B. Related Sections include the following:

1. Division 15 piping Sections for specialty valves applicable to those Sections only.
2. Division 15 Section "HVAC Instrumentation and Controls" for control valves and actuators.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. PTFE: Polytetrafluoroethylene plastic.
4. SWP: Steam working pressure.
5. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for building services piping valves.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads and flange faces.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Lever Handle: For quarter-turn valves NPS 6 and smaller.

G. Extended Valve Stems: On insulated valves.

H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

I. Threaded: With threads according to ASME B1.20.1.

J. Valve Bypass and Drain Connections: MSS SP-45.

2.2 COPPER-ALLOY BALL VALVES (2" AND BELOW.)

A. Manufacturers:

1. Two-Piece, Copper-Alloy Ball Valves:

a. Conbraco Industries, Inc.; Apollo Div.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Hammond Valve.
f. Kitz Corporation of America.
g. Milwaukee Valve Company.
h. Watts Industries, Inc.; Water Products Div.
i. Prior approved equal.

B. Copper-Alloy Ball Valves, General: MSS SP-110.

C. Two-Piece, Copper-Alloy Ball Valves: Bronze body with full-port, chrome-plated and vented bronze ball with blow-out proof stem; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

2.3 FERROUS-ALLOY BALL VALVES (2 ½" AND ABOVE.)

A. Manufacturers:

1. American Valve, Inc.
2. Conbraco Industries, Inc.; Apollo Div.
3. Crane Co.; Crane Valve Group; Stockham Div.
4. Hammond Valve.
5. Kitz Corporation of America.
6. Milwaukee Valve Company.
7. Prior approved equal.

B. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flanged ends.

C. Ferrous-Alloy Ball Valves: Class 150, full port.

2.4 FERROUS-ALLOY WAFER CHECK VALVES

A. Manufacturers:

1. Dual-Plate, Ferrous-Alloy, Wafer Check Valves:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Stockham Div.
    c. Flomatic Valves.
    d. Metraflex Co.
    e. Mueller Steam Specialty.
    f. Prior approved equal.

B. Ferrous-Alloy Wafer Check Valves, General: API 594, spring loaded.

C. Dual-Plate, Class 150, Ferrous-Alloy, Wafer Check Valves: Flangeless body.

2.5 CHAINWHEEL ACTUATORS

A. Manufacturers:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries, Inc.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Sprocket Rim with Chain Guides: Ductile iron or Cast iron, of type and size required for valve.
2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim. Terminate at elevation approved by DSU.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

A. Refer to piping Sections and drawings for specific valve applications. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball valves.
2. Throttling Service: Ball valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Heating Hot Water Piping: Use the following types of valves:

1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
3. Wafer Check Valves, NPS 2-1/2 and Larger: Dual-plate, wafer, Class 150, ferrous alloy.

D. Select valves, except wafer and flangeless types, with the following end connections:

1. For Steel Piping, NPS 2 and Smaller: Threaded ends.
2. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
3. For Steel Piping, NPS 6 and Larger: Flanged ends.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping where possible with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install chainwheel operators on valves NPS 4 and larger and more than 96 inches above floor.

G. Install check valves for proper direction of flow and as follows:

1. Dual-Plate Wafer Check Valves: In horizontal or vertical position, between flanges.

3.4 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Common Work Results for HVAC" for basic piping joint construction.

3.5 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 15112

SECTION 15127 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Thermometers for high temp hot water supply and return.
2. Gauges.
3. Natural gas meters.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule for thermometers, gauges and meters indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For thermometer, gauges and meters signed by product manufacturer.

D. Shop drawings: Schedule for natural gas meters.

E. Operation and maintenance data: Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Miljoco
2. Palmer - Wahl Instruments Inc.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
6. Prior approved equal.

B. Case: Die-cast aluminum or brass, 9 inches long.

C. Tube: Blue reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

I. Must be able to operate at 400° F @ 150 psig.

J. Range 30° F to 400° F.

2.2 THERMOWELLS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Miljoco Corp.
2. Palmer - Wahl Instruments Inc.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
6. Prior approved equal.

B. Manufacturers: Same as manufacturer of thermometer being used.

C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

D. Must withstand 400° F and 150 psig.

2.3 PRESSURE GAGES

A. Manufacturers:

1. Trerice, H. O. Co. Model D82 or equal by
2. Marsh Bellofram.
3. Miljoco Corp.
4. Palmer - Wahl Instruments Inc.

5. Weiss Instruments, Inc.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
7. Prior approved equal.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100. Gauges shall be suitable for high temp water at 150 psig and 400 deg. F.

1. Case: Liquid-filled type, drawn steel or cast aluminum, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Black or other dark-color metal.
7. Window: Glass.
8. Ring: Metal.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Range 0 psig to 200 psig.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 stainless-steel needle type.
2. Snubbers: ASME B40.5, NPS ¼ brass brushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers where shown on the drawings.

B. Provide the following temperature ranges for thermometers:

1. High temp heating Hot Water: 30 to 400 deg F, with 5-degree scale divisions.

3.2 INSTALLATIONS

A. Install direct-mounting thermometers in therm-o-wells with-in the piping and adjust vertical and tilted positions.

B. Install thermowells with socket extending one-half of diameter of pipe and in vertical position in piping tees where thermometers are indicated.

3.3 GAGE APPLICATIONS

A. Install liquid-filled-case-type pressure gages where shown on the drawings.

3.4 INSTALLATIONS

A. Install direct-mounting pressure gages in piping tees or thred- o -lets with pressure gage located on pipe at most readable position.

B. Install needle-valve and snubber fitting in piping for each pressure gage for fluids.

3.5 CONNECTIONS

A. Install meters and gages to allow service and maintenance for meters, gages, machines, and equipment.

B. Ground equipment according to Division 16 Section “Grounding and Bonding.”

C. Connect wiring according to Division 16 Section “Conductors and Cables.”

D. Connect gas meters to Building Automation System.

E. See individual section for gas meter specifications.

3.6 ADJUSTING

A. Adjust faces of thermometers and gages to proper angle for best visibility.

END OF SECTION 15127

SECTION 15181 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-water heating piping.
2. Drain piping.
3. Air-vent piping.
4. Safety valve-inlet and outlet piping.

B. Related Sections include the following:

1. Division 15 Section "Insulation for HVAC Piping".
2. Division 15 Section “General Duty Valves”.

1.3 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. High temp hot-Water Heating Piping: 150 psig at 350° F.
2. Drain Piping: 100° F.
3. Air-Vent Piping: Equal to the pressure of the piping system to which it is attached.
4. Safety valve inlet and outlet piping: Equal to the pressure of the piping system to which it is attached.

1.4 SUBMITTALS

A. Product Data: For each type of the following:

1. Valves. Include flow and pressure drop curves based on manufacturer's testing for automatic flow-control valves.
2. Chemical treatment.

B. Welding certificates.

C. Qualification Data: For Installer.

D. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

1.6 EXTRA MATERIALS

A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion. Use same chemicals as now being used.

B. Coordinate with DSU personnel for chemical treatment.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 106, seamless black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Class 300 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Class 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Class 300 as indicated in Part 3 "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Class 300; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Flanged.
3. Facings: Raised face.

H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, maximum thickness unless thickness or specific material is indicated.

a. Narrow-Face Type: For raised-face, Class 150, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

D. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.3 VALVES

A. Ball and Butterfly Valves: Comply with requirements specified in Division 15 Section "Valves."

2.4 AIR CONTROL DEVICES

A. See detail on drawings for drain and vent:

2.5 CHEMICAL TREATMENT

A. The chemicals used at Dixie State University are from Powers Engineering.

B. Contractor shall contract with Powers Engineering for the clean-out and fill of new and existing hot water piping.

2.6 Y-PATTERN STRAINERS

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Bailey.
   b. Crane.
   c. Flo-Fab.
   d. IFC.
   e. Metraflex.
   f. Spirex.Sarco.
   g. Walworth.
   h. Zurn.

2. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
4. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
5. CWP Rating: 125 psig.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, 2 inch and smaller, shall be the following:

1. Schedule 40 steel pipe; Class 150, cast-iron fittings; cast-iron flanges and flange fittings; and welded joints.

B. Hot-water heating piping, aboveground, 2-1/2 inch and larger, shall be the following:

1. Schedule 40 steel pipe, class 150, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Drain Piping: Hot water: Sch. 40 steel, class 150 cast iron fitting with threaded joints.

D. Air-Vent Piping:

1. Inlet: Same as service for drain piping noted above.
2. Outlet: Same as service for drain piping noted above.

E. Relief Valve Piping:
1. Schedule 40 steel pipes; class 150, cast-iron fittings, cast-iron flanges and flange fittings; and welded or screwed joints.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves where shown on the drawings.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping to permit valve servicing.

C. Install piping free of sags and bends.

D. Install fittings for changes in direction and branch connections.

E. Install piping to allow application of insulation.

F. Select system components with pressure rating equal to or greater than system operating pressure.

G. Install drains, consisting of a weld - o – let, ball valve 600# and short threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage. See detail on drawings.

H. Reduce pipe sizes using eccentric reducer fitting installed with level side on bottom.

I. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the side or top of the main pipe.

J. Install valves according to Division 15 Section "Valves."

K. Install unions in piping 1 1/2” and smaller, adjacent to valves and elsewhere as indicated.

L. Install flanges in piping where shown and elsewhere as indicated.

M. Identify piping as specified in Division 15 Section "Mechanical Identification."

3.4 HANGERS AND SUPPORTS

A. Seismic restraints are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping. Hangers shall be on outside of insulation.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points and manual drains at low points in piping, as detailed on the drawings.

3.7 CHEMICAL TREATMENT

A. Chemical treatment is existing and the WTC is Powers Engineering. Existing water treatment and chemical shall be used for the new fill of the heating hot water. This contractor shall pay for all chemicals required for new fill and cleaning.

B. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products within boiler room. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

C. Add initial chemical treatment and maintain water quality in existing ranges for the first year of operation.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
3. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
4. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any valve, or other component in system under test.
4. After hydrostatic test pressure has been applied for at least 4 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
5. Prepare written report of testing.
6. State Inspector shall witness this test.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect air vents at high points of system and determine if all are installed and bleed air completely (manual type).

END OF SECTION 15181

SECTION 15195 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Gas meter.

1.3 DEFINITIONS

A. Exposed, Interior Installations: Exposed to view indoors. Examples include mechanical equipment rooms.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
3. Pressure regulators. Indicate pressure ratings and capacities.

B. Welding certificates.

C. Field quality-control reports.

D. Operation and Maintenance Data: For pressure regulators and meter to include in operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Owner no fewer than 72 hours in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Owner's permission.

1.9 COORDINATION

A. Location of existing gas piping, tie-in points and any obstacles that may hinder pipe routing.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

   a. Material Group: 1.1.
   b. End Connections: Threaded or butt welding to match pipe.
   c. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.

2.2 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 MANUAL GAS SHUTOFF VALVES

A. See "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. BrassCraft Manufacturing Company; a Masco company.
   b. Conbraco Industries, Inc.; Apollo Div.
   c. Lyall, R. W. & Company, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Perfection Corporation; a subsidiary of American Meter Company.
   f. Prior approved equal.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.4 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Actaris.
   b. American Meter Company.

c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
d. Invensys.
e. Richards Industries; Jordan Valve Div.
f. Prior approved equal.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig.

2.5 GAS METER

A. General requirements

1. Suitable for natural gas.
2. Shall be suitable to connect to the Honeywell Automation System.

B. Thermal mass flow meter insertion type

1. Manufactures: Subject to compliance with requirements, provide the following product.

   a. Onicon F-5100
   b. Prior approved equal.

2. Accuracy: ± 1.0 Percent of reading from 500-7000 SFPM
   ± 2.0 percent of reading from 100-500 SFPM.
3. Overall flow range: 5 to 35,000 SFPM.
4. Sensing method: Thermal mass flow utilizing hybrid analog/ digital sensing circuitry, no moving parts.
5. Input Power: Standard 24 V DC ± 10 percent, 100 mA maximum current.
6. Temperature Range: Standard -40ºF to + 150ºF.
7. Ambient temperature range: -5ºF to 150ºF.
8. Max operating pressure: 200 PSI.

9. Materials of construction.

    a. Wetted Metal Components- 316L stainless steel.

10. Enclosure Rating: Weathertight, Nema 4.
11. Output Signals

    a. Analog Output- 4-20 mA
    b. Scalable pulse output: Isolated dry contact, contact rating 50 V DC @ 100mA

12. Provide easy to read display head.

C. Install gas meter per installation instructions and recommendations provided by onicon.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections to existing gas piping, before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect the existing natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping at right angles and parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Locate valves for easy access.

E. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Verify final equipment locations for roughing-in.

I. Comply with requirements in Sections specifying the gas-fired boilers for roughing-in requirements.

J. Drips Leg: Install drip leg at bottom of gas piping drop. Locate where accessible to permit cleaning and emptying.

1. Construct drip leg using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

K. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap and insert screen.

L. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

M. Connect branch piping from top or side of horizontal piping.

N. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

O. Do not use natural-gas piping as grounding electrode.

P. Install strainer on inlet of pressure regulator.

Q. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 15 Section "Meters and Gages."

R. See CSD-1 gas train detail on drawings.

3.4 VALVE INSTALLATION

A. Install manual gas shutoff valve for each branch serving boilers #1, and 2. See gas train for other valve installations.

B. Install regulators and gas train with maintenance access space adequate for servicing and testing.

3.5 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.6 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

B. Comply with requirements for pipe hangers and supports specified in Division 15 Section "Hangers and Supports."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.

3.7 CONNECTIONS

A. Connect to existing 2” gas main inside building where shown on the drawings and according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas fired equipment grounding conductor of the circuit powering the boiler according to NFPA 70.

C. Install piping adjacent to boiler to allow service and maintenance of boiler and gas piping.

D. Drip Leg: Install tee fitting with capped nipple in bottom of gas drop to form drip leg.

3.8 LABELING AND IDENTIFYING

A. Comply with requirements in Division 15 Section "Mechanical Identification" for piping and valve identification.

3.9 PAINTING

A. Paint exposed, interior metal piping, valves, service regulators, and piping specialties, except components, with factory-applied paint or protective coating. See color chart in section “Mechanical Identification”.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

a. Prime Coat: Quick-drying alkyd metal primer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex (semigloss).
d. Color: By owner. See color chart.

B. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 INDOOR PIPING SCHEDULE

A. Aboveground, branch piping shall be the following:
1. Steel pipe with malleable-iron fittings and welded and threaded joints.

B. Aboveground, distribution piping 2” and larger shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller shall be the following:

1. Two-piece, full port bronze ball valve with bronze trim.

B. Valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim flanged.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. Two-piece, full-port bronze ball valve with bronze trim.

D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim flanged.

END OF SECTION 15195

SECTION 15515 - WATER-TUBE BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes providing two knocked -down packaged, field erected and -assembled, flextube gas-fired, water-tube boiler, trim, and accessories capable of generating high temperature hot water.

1. Factory assembled, and broken down shipped to site and assembled in the existing mechanical boiler room by the boiler manufacturer's personnel. There is no other way to get the boilers into this room.
2. Forced-draft gas burner.
3. Controls.

1.3 SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boiler, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.
2. Wiring Diagrams: Power, signal, and control wiring.

C. Source quality-control test reports.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For boiler, boiler components, and accessories to include in operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

G. Other Informational Submittals:

1. ASME "S" Stamp Certification and Report: Submit "S" stamp certificate of authorization as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
2. Startup service reports.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code, Section 1.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas Fired Boilers - Minimum Efficiency Requirements."

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."

E. I=B=R Compliance: Boilers shall be tested and rated according to HI's "Rating Procedure for Heating Boilers" and "Testing Standard for Commercial Boilers," with I=B=R emblem on a nameplate affixed to boiler.

F. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to the Utah State Boiler Inspector.

G. UL/CUL Tested and Certified.

1.5 COORDINATION

A. Coordinate size and location of existing concrete boiler bases. Provide anchor-bolt into existing concrete bases.

B. Coordinate electrical and controls with existing systems.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace drums, tubes, headers, cabinets, gas burners, and pressure vessels of new boiler that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Drums, Tubes, Headers, Cabinets, and Gas Burner: Five years from date of Substantial Completion, non-pro rata and from date of acceptance by the State of Utah.

2. Warranty Period for Pressure Vessel: 25 years from date of Substantial Completion, for thermal shock.

PART 2 - PRODUCTS

2.1 STEEL FLEXTUBE WATER-TUBE BOILERS B-1 AND B-2:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cleaver Brooks Model FLE-500 –HW
2. Unilux Model ZF 500W-1-250
3. Bryan RV500
4. Prior approved equal.

B. Description: Factory-fabricated and field-assembled, water-tube boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket, flue-gas vent connection, supply and return connections, and controls.

1. Supply and install two steel bent water tube boilers of the size and capacities as outlined in the equipment schedule. Boilers shall be of the 4 sided water wall furnace design with tangentially arranged tubes creating 5 linear gas passages travelling the full length of the boiler. Boiler shall be completely factory assembled including forced draft burner, controls, components and safety devices as specified herein. Complete boiler assembly in the field shall be tested prior to shipment by the manufacturer.
2. Boiler shall be designed and manufactured to have a rating of 5000 MBH input and 4250 MBH output with a minimum combustion efficiency of 84%. Boilers shall be designed and constructed as per ASME code, section 1 and shall be stamped for a maximum allowable working pressure of 160 PSIG and a maximum allowable temperature of 350° F.
3. Boiler shall be UL Listed and Labeled. It is the contractor’s responsibility to insure that the packaged boiler complies with State codes.
4. Seismic Fabrication Requirements: Attach boiler pressure vessel, accessories, and components with anchor bolts strong enough to withstand seismic forces defined in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment" when boiler mounting base is anchored to existing concrete bases.

C. Pressure Vessel Design – Heat Exchanger:

1. Boilers shall be of the dual drum industrial style bent water tube type with a 4-sided tangent water wall furnace. Water walls shall be on the top, bottom and both sides. No refractory or insulation shall be used on any sidewall.
2. No furnace seal shall be made by the meeting of two tube hairpin bends.
3. The fireside of the boiler shall have five (5) longitudinal gas passes, travelling the full length of the boiler, separated with tangential water wall tubes to insure maximum linear gas travel, increased gas side velocities and improved gas side

heat transfer coefficients. Products of combustion shall flow horizontally through the boiler across boiler tubes.

4. Stainless steel cross flow turbulating baffles shall be installed in the second and fourth passes to provide increased hot gas turbulence, increased furnace pressure and improved flue outlet temperature control.
5. All tubes shall be exposed to radiant luminous heat in the boiler furnace to create high water flow rates at all loads and substantially increase heat transfer in the convection zones outside the furnace.
6. Boiler tubes shall be SA 178 Grade A and shall be no less than 1 ½" dia., .095 wall thickness, made of only domestic U.S. steel and shall be easily removed and replaced without need for any welding or rolling. Tubes directly beneath the flue gas outlet shall be easily removable without the need to disconnect, move or modify the flue outlet cover arrangement or raise / remove any part of the boiler roof panels. There shall no more than one (1) 180 deg. bend in any single boiler tube. All tube bends shall be made with a mandrel type industrial bender to insure maximum I.D. opening at each bend. The tube-to-drum attachment: The tube shall be fitted with a tapered ferrule which shall be press-fit into the tube hole in the drum. The ferrule shall be welded to the tube at the factory. The tube shall be held in place with a keeper plate.
7. Boiler vessel design shall insure that total boiler tube lengths shall be equal on each side of the vessel to maintain balanced flow through boiler.
8. A large down comer shall be located external to the boiler housing. Down comers shall provide natural internal circulation without requiring external pumping sources.
9. Boiler shall have an air vent connection located at the highest point of the vessel and one (1) hand hole type inspection opening at each end of each drum with yolk type covers. Threaded pipe type openings will not be accepted. Lower drum shall have a 90 deg. threaded drain opening at the rear and front of the vessel at the lowest point as standard. Observation ports for inspection of flame conditions shall be provided at the rear of the boiler, and in the burner assembly at the front.
10. The furnace heat release shall not exceed 45,000 BTU/hr per square foot of heating surface exposed directly to the radiant flame. For boilers with heat releases greater than 45 000 BTU/hr per square foot of heating surface, then a minimum of 5 square feet of total heating surface per boiler horsepower shall be required. The furnace volumetric heat release shall not exceed 67,000 BTU/hr per cubic foot of furnace volume.

D. Housing and Jacket Construction:

1. The boiler base shall be constructed of heavy gauge steel. Base shall be poured with one layer of 1900 deg. F insulating refractory to cover all base plate steel contact points. An additional 2 inch layer of 2700 deg.F castable refractory shall then be poured covering the insulating refractory. The high temperature refractory shall have no contact points with the boiler base steel. Boiler bases insulated with mineral fiber wool type insulation shall not be acceptable.
2. The rear target wall shall be of industrial grade heavy-duty construction. Wall shall be constructed of no less than 4" of 1900 deg. F insulating poured refractory, 1" of high temperature mineral board and 4" of 2700 deg. F castable refractory. The high temperature refractory shall have no contact points with the boiler furnace wall steel. Total thickness of the rear furnace wall shall be not less

than nine (9) inches. Stainless steel stays shall be permanently welded to the steel rear wall enclosure in intervals of at least every ten (10) square inches. Rear wall shall be warranted against “hot spotting” failure on the outside enclosure for a period of not less than five (5) years. Rear wall shall incorporate burner observation sight glass.

3. Other insulation methods that provide the same kind of protection is acceptable.
4. The front wall shall be constructed of the same industrial grade materials as the rear wall described above. Total wall thickness shall be no less than seven (7) inches. Blanket or fiber wool insulated type front and rear walls are not acceptable.
5. Boiler inner casing shall be fabricated of not less than 11 gauge reinforced steel. Entire boiler casing shall be comprised of “bolt on” type panels. Each panel shall be independently insulated with a minimum of three (3) inches of 2400 deg. F fiber wool insulation. Each panel shall be easily removable and replaceable with standard hand tools.
6. Roof panels shall be constructed of not less than 11 gauge reinforced steel and insulated with not less than one (1) inch of high temperature insulating fiber board. Board shall be affixed to the roof panel by stud nails and 1 ½” collar stays at four (4) inch seam intervals. Roof panel shall be supplied with a factory installed round flanged smoke outlet with top outlet position located on the centerline of the boiler at the rear.
7. Entire inner housing shall be fully sealed with industrial grade ½” bolts, washers and nuts, at a maximum spacing or 8 inches and gaskets to insure that the products of combustion are contained within the boiler up to 5” w.c. pressure.
8. Boiler outer jacket shall be constructed of 20 gauge insulated removable steel side panels. Overall boiler inner / outer housing design shall allow for a two (2) inch insulating air space between the inner and outer panels. Outer panels shall be finished with a rust resistant, polyester paint impregnated powder coat finish. Panels shall be painted WHITE.
9. The overall heat losses through boiler housing and jacket panels shall not exceed 0.50% of maximum input rating. Outer skin temperatures of the jacket panels shall be no greater than 20 degrees Fahrenheit above ambient room temperature.
10. The combustion chamber shall be easily accessed through a rear access door for inspection and required maintenance. All boiler and jacket panels shall be easily removed and replaced, using only standard hand tools, for access to all boiler tube surfaces.

E. Boiler Trim & Controls:

1. Shall comply with the requirements of ASME CSD-1 requirements.
2. Safety relief valves or valve shall be in accordance with the appropriate ASME code Section 1 dated for high pressure 1 high temperature hot water application and with state and local requirements.
3. Boiler operating trim shall consist of not less than the following:

    a. Temperature control for regulation of burner operation.
    b. Temperature sensing element located adjacent to boiler outlet.
    c. Water relief valves.
    d. Independently mounted 3” dial thermometer;

e. Independently mounted 4 ½" pressure gauge;
f. Probe type Low Water Cutoff, manual reset type; Mounted in the upper drum and wired to the burner control circuit.
g. Above listed boiler controls shall be factory piped and wired. Operating, Modulating and High Limit Controls shall be furnished as a flush mounted factory control package, model CP1-V160W by Unilux and affixed to the front of the boiler in plain view. All trim and control wiring shall be routed to the clearly marked strip in the panel. All trim and control wiring shall be housed in an approved casement.
h. Auxiliary low water cut-off.
i. Stack Thermometer.

F. Field Erect Boiler:

1. New Boilers B-1 and B-2 shall be field erected (FE).

a. Entire assembly shall be manufactured specifically for FE assembly;
b. Vessel, base, housing, jacket, controls and fuel burning equipment shall be shipped loose for site assembly by Factory or a factory team only;
c. Entire boiler assembly shall be constructed in components and shipped directly from the manufacturer as an FE assembly;
d. All components shall be clearly labeled for inspection at time of delivery.

2. Factory Shipped Components.

a. Boiler shipped in components. Upper drum, lower drum and downcomers shipped loose with flanged connections. Tubes, hand hole covers, front and rear furnace walls, boiler base, uppers, roof, required insulation, burner, controls, control piping, wiring harness and insulated jackets shipped loose for field assembly.

3. Vessel.

a. Vessel shall be factory prepared and tested;
b. All connections shall be flanged for site assembly;
c. Flanges shall only be 150# industrial grade. Flanges shall be permanently marked at time of factory fit up to insure proper field assembly. Necessary gaskets and seals shall be part of this assembly.

4. Housing.

a. Housing shall be insulated. Insulation shall be affixed with permanently welded studs and clips. Glued insulation to housing panels is not acceptable.
b. Housing shall be constructed of not less than 11 gauge heavy duty steel. All housing components shall be heavily reinforced using steel cross members. Housing shall be assembled with factory supplied heavy duty ½" nuts and bolts spaced at no more than 8" intervals.

5. Jacket

a. Jacket shall be manufactured in panels that may be easily and individually handled. Panels shall be pre-tested for quality and exact fit.
b. All required attachment hardware shall be part of this assembly.

6. Refractory.

a. Refractory shall be factory poured and air cured. There shall be no pouring of refractory at the jobsite.

7. No Field Welding.

a. There shall be ABSOLUTELY NO WELDING required on site for the assembly of the boiler, housing and jacket.

8. Field Assembly by Manufacturer.

a. Boiler shall be field assembled by the boiler manufacturer only. NO third party assemblers shall be permitted;
b. Mechanical Contractor shall coordinate with the manufacturer's representative and factory foreman to insure proper placement of components in boiler room prior to assembly. Manufacturer-direct crew to assemble entire boiler on site and provide for third party ASME Authorized Inspector testing and stamping;
c. Vessel shall be field inspected per the ASME Code by an Authorized Inspector. Under no circumstances is it allowable to have a vessel that was "pre-stamped" or assembled at manufacturers' factory, then disassembled for shipment and jobsite re-assembly. MANUFACTURER shall submit a minimum of three (3) field erect projects by MANUFACTURER within the past two (2) years.

G. Burner:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cleaver Brooks- V Series Profire low nox gas burner model LNVG, or equal by.
b. Power flame
c. Bryant Burner
d. Prior approved equal.

H. Scope

1. This specification shall govern the construction, features, materials, fabrication, and inspection of "package type" field assembled, natural gas burner and all necessary appurtenances, controls and auxiliary equipment for mounting to new boilers.
2. Any deviation from this specification shall be specifically noted in submittal, of proposal. All request for design deviations shall be presented in writing at least seven (7) days prior to bidding.

I. General Requirements

1. Furnish and install on each new boiler a low nox gas burner. The complete burner shall be listed with UL and bear the UL label and shall be completely assembled, wired, and factory tested. The burner shall meet the requirements of CSD-1. Each burner shall be a high radiant multi-port type.
2. The burner manufacturer shall provide all necessary equipment, accessories, parts and services required by these documents.
3. The burner manufacturer shall supervise and direct the building of the burner and equipment, using the manufacturer's best skill and attention. The manufacturer shall be solely responsible for construction means, methods, techniques, sequences and procedures and for coordinating all portions of the burner.
4. Guarantee:

    a. The burner manufacturer shall guarantee the burners shall produce the BTU requirements shown in the schedule while being fired with natural gas at the specified operating conditions.
    b. Performance and efficiency tests shall be conducted after completion of start-up. The manufacturer shall have a representative in attendance at the time the tests are conducted.
    c. All equipment shall be guaranteed against defective design, workmanship, or material for one year from date of initial operation.

J. Standards and Codes:

1. Manufacturer shall ensure that the burner shall comply with the latest provisions of laws, Codes and standards applicable to the equipment and burner which are in effect on the construction date.
2. On points of difference within or between laws, Codes and standards, the law, Code or standard having the most stringent requirements shall govern.
3. Nothing contained in the Specifications shall be construed as authority or permission to disregard or violate any Code, ordinance, statue or regulatory requirement.
4. The manufacturer shall not be relieved of obligations of the burner and equipment to perform in accordance with these Documents by tests, inspections or approvals required or performed by persons other than the manufacturer.
5. The following regulatory codes, standards, and Publications, form part of this specification. All applicable components shall be designed and constructed in accordance with these codes, with additions or modifications as required by this specification.

    a. ASME Boiler and Pressure Vessel Code
    b. ASME Power Test Code
    c. ABMA Manual of Industry Standards
    d. CSD-1 Requirements

6. Burner shall comply with all state and federal regulations. Including but not limited to:

    a. Utah Boiler and Pressure Vessel Code current edition

b. International Mechanical Code (IMC)
c. International Plumbing Code (IPC)
d. National Fire Protection Association (NFPA)
e. UL/cUL

K. Instructions and Data Sheet

1. The burner manufacturer shall provide 3 hard copies of installation manuals with shipment of burner.
2. The burner manufacturer shall furnish 3 hard copies and 1 electronic (.PDF) copy of operating instruction manuals, certified prints, ASME Manufacturer's Data Sheets and operation test data. This documentation shall be provided at the completion date.

L. The Vendor shall conduct required tests and pre-assemble appropriate components prior to shipment.

2.2 DESIGN REQUIREMENTS

A. Operating Conditions

1. Design Continuous Capacity . .Burner 1 & 2 . . . . . 5,000 MBH
2. Elevation above Sea Level. . . . . 2860 Ft
3. Electrical Characteristics. . . . . .460 Volts . . . 3 Phase . . . 60 Hertz
4. Primary Fuel . . . . Natural Gas 2 PSIG
5. Standby Fuel . . . . . None

B. Fuel

1. Burners shall be designed to operate using natural gas. Natural gas will be supplied at 2 PSIG.
2. In determining the performance of the burners and in the absence of specific fuel analysis, the following ultimate analyses shall be used.

Natural Gas

BTU	919 BTU/CF
Methane, CH_4	90% by volume
Ethane, C_2H_6	5% by volume
Nitrogen, N_2	5% by volume

C. General Conditions.

1. This specification covers the construction of one natural gas fired burner to develop the above stated maximum capacity.
2. Material shall be as specified herein. Material not specifically stipulated shall be of the best commercial quality. All materials shall be free from defects that might affect the serviceability of the finished product.
3. The equipment shall be essentially the standard product of the manufacturer so prompt and continuous service can be assured. The accessory equipment or component parts of the unit need not be the product of the same manufacturer.

2.3 BURNER CONSTRUCTION

A. Burner: Provide and install two gas fired low nox burners with capacities as shown and scheduled on the drawings. Burners shall be welded construction for natural gas.

B. General Requirements

1. Furnish and install two gas fired low nox burners. The burner design, construction, components and installation shall meet all applicable code requirements.
2. The new burners shall be installed on new boilers #1 and #2.
3. Burner assembly shall be attached to the front boiler wall with integral hinges. This shall permit the burner to swing out.

C. General Burner Description

1. The new burner shall be forced draft flame Burner for new boilers #1 and #2. Gas pressure applied to the burner gas train supply connection shall be 2 PSIG at full high rate.
2. The gas burner shall burn the specified quantity of fuel without objectionable vibration, noise, or pulsation, with not more than 15% excess air.

D. Approval Codes

1. All equipment and installation procedures will meet the requirements of NFPA 8501 for new boilers #1 and #2. Burners shall be designed and constructed as an integrated combustion system package and shall be factory fire tested.

E. Combustion Head Design

1. All air required for combustion shall be supplied by a centrifugal axial air flow blower mounted integral to the burner. The blower wheel shall be of the backward curved impeller with self-cleaning vanes. A dual blade damper assembly located on the inlet side of the blower wheel shall meter the combustion air flow. .

F. Ignition System

1. The burner ignition system, shall light the main gas, and shall utilize natural gas as the fuel source. Ignition shall be of the interrupted gas electric type. The gas

pilot system components shall include a pilot solenoid valve, pilot gas pressure regulator automatic pilot gas valve and ignition transformer and manual gas shutoff cock. Burners shall be equipped with parallel positioning that will eliminate linkage.

G. Gas Control Train

1. CSD-1 Requirements
2. See detail on drawings.
3. Provide a pressure gauge to indicate the gas burner manifold pressure.
4. Furnish and install one manually operated plug or ball valve upstream of all valves.
5. Provide main gas pressure regulator of tight shutoff type with vent to outside atmosphere, in accordance with local codes.
6. Provide automatically operated motorized safety gas valve. One safety shutoff valve shall be proven closed during pre-ignition by proof of valve closure interlock switch on valve.
7. Provide a second automatically operated gas safety shutoff valve to operated simultaneously with the above gas valve.
8. A manually operated gas valve shall be located between the automatic gas valves to permit leakage testing of the valves.
9. Gas pressure monitoring shall be provided by approved pressure switches interlocked to accomplish a non-recycling safety shutdown in the event of either high or low pressure.

H. Pilot Gas Train

1. CSD-1 Requirements
2. See detail on drawings
3. A separate pilot gas cock, gas pressure regulator, and pilot shut-off gas valve shall be provided for the ignition gas supply.

I. Interlocks

1. The induced draft fan operation shall be electrically interlocked with the burner operating circuit to insure that the burner will not operate if the draft fan is not operating or if the draft is below a preset level.
2. Provide dry contacts in the burner control panel for connecting into the building's Honeywell Automation System. See section 15900

J. NOx Emissions Reduction -Low NOx Burner

1. Burner shall be low NOx type, U.L. listed specifically for reduced emissions service. Burner NOx reduction strategy shall reduce the production of NOx by controlling low excess air operation and reducing flame temperature.
2. Low NOx Burners

   a. Type: Induced Flue Gas Recirculation (IFGR).

1) Burners shall be equipped with a burner mounted induced FGR purge assembly, complete with motor driven diverter damper valve to ensure that FGR is not introduced into the burner combustion air during the pre-purge, ignition, initial main flame establishment, or post purge cycles.
2) The induced FGR piping shall be extended from the boiler flue connection to connect into the new burner FGR inlet connections. FGR piping shall be seamless carbon steel pipe or tubing, minimum Schedule 10. Piping insulation shall be provided and installed for new FGR piping by contractor.
3) On natural gas firing, NOx emissions shall not exceed 30 PPM, and CO emissions shall not exceed 50 PPM. All emissions measurements are to be corrected to 3% O_2.
4) Burner Start-Up Information and Test Data Form must include NOx and CO emissions measurements. Form, completed with all test data values, shall be furnished to DFCM and the Engineer prior to final payment.

2.4 BOILER CONTROL SYSTEM

A. General

1. Description

a. Each boiler shall be factory equipped with a Boiler Control System providing technology and functions equal to the Cleaver Brooks Hawk 1000 Boiler Control system.
b. Each Boiler Control System shall be factory equipped with a pre-configured Programmable Logic Controller with OPC Ethernet I/P standard communication capabilities and a 6” inch color touch screen Human Machine Interface (HMI).
c. Dedicated Independent Burner Management System for Flame Safeguard Control.

B. Products

1. Major System Components

a. Major system components shall include:

1) Rockwell/Allen Bradley L24ER Compact Logix Programmable Control Processor.
2) 6 Inch Color Touch Screen HMI.
3) Local Modbus network with Parallel Positioning Actuators
4) Various Controller Input/Output Modules.
5) One Independent Burner Management controller and Wiring sub-base.
6) One Flame Scanner: Infrared, Ultra-Violet, or UV Self-Check.

7) One Flame Amplifier, to correspond with the selected Flame Scanner.
8) Various Temperature and Pressure Sensors.
9) Alarm Bell

b. Major functions that the Boiler Control System shall provide:

1) Automatic sequencing of the boilers through standby, pre-purge, pilot flame establishing period, main flame establishing period, run and post purge.
2) Flame proving and lockout on flame failure during pilot flame proving, main flame proving, or run.
3) Low fire damper/valve position for flame ignition trials.
4) Parallel Positioning Combustion Control for Natural Gas including combustion air damper and optional Flue Gas Recirculation damper control.
5) O2 Monitoring and Trim (air trim)
6) Utilize solid state controls and sensors to provide various control functions, such as:

a) Parallel Positioning Combustion Control with Full Modulation
b) O2 trim control
c) Modulating Control algorithm shall be Proportional-Integral-Derivative (PID) type.
d) Local Set Point 2 boiler lead/lag control.
e) Thermal Shock Protection based on shell water temperature.
f) Various high and low limit alarms and shutdowns.

7) Touch Screen graphical operator interface and monitoring.

a) Minimum 4 inch color
b) Manual control of the boiler-firing rate utilizing control screens on the HMI to increment and decrement the firing rate.
c) On screen real-time display of all connected process parameters.
d) On screen commissioning of boiler set points and configurable alarms.
e) On screen display of system alarms and faults.

8) Expand Annunciation
9) Building/Plant Automation System Interface (requires the optional CB-PT for protocols other than OPC compliant Ethernet I/P to use this feature).
10) High Stack Flue Gas Temperature Monitoring, cut-off and alarm.
11) Low O2 alarm.
12) Tamper resistant control logic and password protection.
13) Dual set point (night/day set back) capabilities (used for local set point 2 boiler Lead lag control).
14) Outdoor reset for hot water boilers.
15) Hot stand by.

16) Alarm silencer via touch screen HMI.

C. The Boiler Control System shall provide the following safety provisions for:

1. Integrated Burner Management

   a. Examine all load terminals to assure it is capable of recognizing the true status of the external controls, limits and interlocks. If any input fails this test, the burner management system should lockout on safety shutdown.
   b. Closed-loop logic test verifies integrity of safety critical loads (ignition, pilot, and main fuel valves) and must be able to lockout on safety shutdown if any safety critical load is identified as proper or improper.
   c. Pre-ignition interlocks (fuel valve proof of closure, etc.) and false flame signal checked during Standby and Pre-Purge.
   d. Dynamic checking of the flame signal amplifier. The control flame signal amplifier must be able to recognize a no flame signal during this dynamic amplifier check.
   e. Safe start check and expanded check to include monitoring flame signal during standby.
   f. High and low fire switches monitored for proper sequencing.
   g. Tamper-proof Purge Timing and safety logic.

2. Integrated Boiler Operating Controls and Security features

   a. Operating and Modulating Control.
   b. Password protection of Programmable Controller logic.
   c. Password protection of Parallel Positioning Set Up and Commissioning screens.
   d. Password protection of Critical Set Point Screens.

3. The Boiler Control System shall provide annunciation and diagnostics:

   a. Active Alarm Annunciation
   b. Indication of failures at start up or during normal operation.
   c. Provide historical alarm information for on screen display.
   d. Detects and isolates an alarm, and reports internal circuit faults.
   e. Primary and Secondary Low Water Shutdown and Alarms.

4. The Boiler Control System shall be able to operate in these environmental conditions.

   a. Supply Voltage: 120vac (+10%/-15%) 60 Hz.
   b. Maximum total connected load: 2000 VA.
   c. Operating temperature limits: 32 to 130^{f}.
   d. 85% RH continuous, non-condensing, humidity.
   e. 0.5G continuous vibration.

5. All Boiler Control System wiring shall be in accordance with the National Electrical Codes and local electrical codes.

6. System shall meet current NFPA85 requirements.
7. System shall meet UL 1998 requirements with Cross Limited Feedback.
8. Boiler Control System component functions shall be as follows:

    a. Burner Management Controller: Provides boiler sequencing logic to meet FM/UL and other approval body requirements.
    b. Touch Screen Graphical Interface (6 Inch Color Minimum): Provides user interface to the control system, boiler overview screen with connected boiler parameter readouts, alarm screens, optional water level indication, and system firing rate screen at a minimum
    c. Local closed loop Modbus Communication Network for communication with Parallel Positioning Actuators.
    d. Various Programmable Controller Input/Output modules: Provides interface for discrete powered and/or isolated relay signals, as well as for analog signals, from external input devices.
    e. Stack Temperature Sensor: Measures and transmits a signal to the Programmable Controller in relation to boiler exit flue gas temperature for indication. Also used for high stack temperature alarm and shutdown.
    f. Water Temperature Transmitter for Hot Water Boilers: Provides an analog signal to the Programmable Controller for indication of boiler water temperature. Utilized for thermal shock protection, on/off, and modulation control of the burner.

9. Optional Equipment/Features (also see individual Boiler Book sections below)

    a. O2 Air Trim Control.
    b. Local set point 2 boiler lead/lag control.
    c. Remote Firing Rate (modulation input via remote communications option.
    d. Outdoor Temperature Reset (Hot Water)
    e. Hot Water Return Temperature
    f. Building/Plant Automation System interface (requires the CB-PT to use this option for protocols other than OPC compliant Ethernet I/P).
    g. Remote Monitoring and Data Acquisition System (SCADA) (Requires the CB-PT to use this option for protocols other than OPC compliant Ethernet I/P).

2.5 BURNER START UP & TEST DATA

A. The following information shall be recorded for burner start up:

1. Model No., Serial No., and Job No. of Burner
2. Installation Name Start Up Date
3. Start Up Contractors Name Phone
4. Name of Technician doing Start Up
5. Type of Gas: Natural
6. Gas Firing Gas Pressure at Train Inlet.
7. Low Fire “W.C.”
8. High Fire “W.C.” Gas Pressure at Pilot Train.
9. Inlet (if applicable) “W.C.”

10. Gas Pressure at Firing Head Low Fire “W.C. Gas Pressure at Pilot Test High Fire “W.C. Tee (if applicable) “W.C.
11. Gas Pressure at Pilot Test
12. Low Fire PSIG High Fire PSIG
13. Flame Signal Readings D.C. Volts.

2.6 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 16 Sections and provided by the Electrical Design Build Contractor.

B. Single Point Field Power Connection: Factory-installed and wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color-coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.
4. Field power interface shall be to fused disconnect switch.
5. Provide branch power circuit to each motor and to controls with disconnect switch.
6. Provide each motor with overcurrent protection.

2.7 CAPACITIES AND CHARACTERISTICS: SEE DRAWINGS

2.8 SOURCE QUALITY CONTROL

A. Test and inspect field-assembled boilers, according to ASME Boiler and Pressure Vessel Code.

B. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

C. Allow Owner access to source quality-control testing of new boilers. Notify Engineer 7 days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installations, examine the existing concrete bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine best locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where new boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Boilers shall be shipped knocked down, and be field assembled in place by boiler manufacturer.

B. Install new boiler level on existing, repaired, and painted concrete bases.

C. Install gas-fired boilers according to NFPA 54.

D. Assemble boiler tubes in sequence and seal each tube joint.

E. Assemble and install boiler trim.

F. Install electrical devices furnished with boiler but not specified to be factory mounted.

G. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Connect gas piping to boiler gas-train inlet with union or flange. Piping shall be at least full size of gas train connection. Provide a reducer if required.

D. Connect hot-water piping to supply- and return-flanges on boiler.

E. Install piping from safety valves to floor.

F. Install piping from equipment drain connections to nearest floor sinks. Piping shall be at least full size of connection. Provide an isolation ball valve.

G. Connect breeching to full size of boiler outlet. Comply with requirements in Division 15 Section 15550 "Breechings, Chimneys, and Stacks" for venting materials.

H. Install flue-gas recirculation (FGR) duct from new breeching to burner for new boilers No 1 and No 2. Comply with requirements in Division 15 Section "Breechings, Chimneys, and Stacks" for recirculation duct materials. FGR piping shall be insulated. Provide control damper.

I. Ground equipment according to Division 16 Section "Grounding and Bonding."

J. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to assemble new boiler in room and to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency.
    b. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
    c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to four visits to Project during other than normal occupancy hours for this purpose.

E. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boiler shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment in order to comply.
3. Perform field performance tests to determine the capacity and efficiency of the new boiler.

    a. Test for full capacity.
    b. Test for boiler at low fire 20, 40, 60, 80, and 100 percent of full capacity.

4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
7. Notify Engineer in advance of test dates.
8. Document test results in a report and submit to Engineer.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the new boilers. Video training sessions. Provide two hours of class time and four hours of field time in training.

END OF SECTION 15515

SECTION 15550 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following, from new boiler connections to new connections into existing breeching.

1. Field-fabricated metal breechings, from new boiler connection to new connections into existing breeching.

2. Existing horizontal breeching and stack through roof shall remain.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Field fabricated breechings.

B. Shop Drawings: For breechings. Include plans, elevations, hangers, sections, details, and attachments to other work.

1. Provide required calculations required for selecting seismic restraints and structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents, breechings, and stacks.

1.5 COORDINATION

A. Coorninate with existing conditions, boiler manufacturer and existing breeching.

PART 2 - PRODUCTS

2.1 FIELD-FABRICATED METAL BREECHINGS AND STACKS

A. Fabricate breechings and stacks from ASTM A 1011/A 1011M hot-rolled steel with continuously welded joints, complying with NFPA 211 for minimum metal thickness.
   1. 24”: 0.123 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Field-Fabricated Metal Breechings and Stacks: Boilers.

3.3 INSTALLATION OF UNLISTED, FIELD-FABRICATED BREECHINGS

A. Suspend breeching independent of boiler connections.

B. Install, support, and restrain according to seismic requirements.

C. Align breechings at connections, with smooth internal surface and a maximum 1/8-inch misalignment tolerance.

D. Support breechings from building structure with bolts, C-clamps, or beam clamps according to manufacturer's written instructions.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Insulate new breeching as noted in section “Insulation” and provide metal coverings.

END OF SECTION 15550

SECTION 15900 - FACILITY MANAGEMENT AND CONTROL SYSTEM (FMCS)

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and service necessary for the modification of the existing FMCS to accommodate the new boiler installations. All labor, material, equipment and software not specifically referred to herein or on the plans, that are required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

1.2 QUALIFICATION OF BIDDERS

A. All bidders must be manufacturers or licensed factory representatives and installers of the manufacturers specified for the local area. Bidders must also be a Certified Systems Integrator for the products specified.

B. Acceptable products:

1. Honeywell ComfortPoint Series JACE & Controllers Embedded Programming tool in JACE (JACE to be referred to as NAC) - open license.

C. Approved bidders:

1. Honeywell Local Branch Office Brad Scott 801-978-7134.

1.3 SYSTEM DESCRIPTION

A. The modification of the existing Facility Management and Control System (FMCS) shall be comprised of digital controllers and communicating via the internet to a host computer in the central pant.

B. The basic controls system also includes all sensors, controllers, instruments, flow switches, automatic valves & actuators: installation and service for a complete and functional controls system.. Control system shall be designed to allow easy field adjustment of all set points and parameters.

1.4 INTENT OF DRAWINGS AND SPECIFICATIONS

A. This specification defines the minimum equipment and performance requirements for the modification of the existing Building Automation System (BAS) and the replacement of sensors etc.

B. The implied and stated intent of the drawings and specifications is to establish minimum acceptable quality standards for device-level integration of material and equipment as well as workmanship and to provide a complete and operable updated BAS.

C. To ensure compatibility and training standards with the present BAS, the system must be fully software certified at the time of installation.

D. The drawings are diagrammatic intending to show a workable general arrangement and location of components and are not necessarily complete or rigid in all details.

1.5 SCOPE

A. Provide all labor, materials, programming and supervision necessary for the modification and upgrade of the existing control systems.

B. The scope of work shall include but not be limited to the following:

1. Replacing controllers and upgrading the existing 500xl panel.

2. Provide all new DDC controls to replace the existing controllers
3. Provide new temperature sensors and transmitters where needed for all AI or UI inputs of the system
4. Provide new HWS slow switches for both new boilers.
5. Provide new open/closed 2- way control valves on HWR piping to each boiler.
6. Provide stack temperature sensor and transmitter
7. Replace existing outside air temperature sensor and transmitter.
8. Each boiler shall be able to indicate: boilers enable, boilers status, boilers alarm, and boiler reset.

C. The Control Contractor shall furnish all electrical control and interlock wiring connected to the controls and instrumentation systems. 110 VAC or greater voltage power wiring shall be provided by Division 16 Design Build Electrical Contractor and coordinated by this Contractor. Failure of this Contractor to coordinate requirements with other Divisions shall result in this Contractor to be responsible for any non-coordinated items.

D. All conduits in connection with the controls and instrumentation system shall be furnished and installed by this Contractor.

E. The Control Contractor shall complete all sensing and control installations including electrical and electronic components, unless otherwise required.

F. Provide a comprehensive operator and technician-training program as described herein.

G. Provide as-built documentation, software, and all DDC control logic and all associated support documentation on approved media, which accurately represents the final installed system.

H. The emergency shut- down button shall be provided and installed by this contractor.

1.6 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division-1, General Requirements, of these Specifications, and Section 15010, “Mechanical General Provisions,” apply to the work specified in this Section.

B. The following sections constitute related work:

1. Section 15010 – General Requirements.
2. Section 15050 – Basic Materials and Methods.
3. Section 15940 – Sequence of Operation.
4. Section 15950 – Test and Balance.
5. Division 16

1.7 COORDINATION

A. The direct digital portions and automatic temperature control system shall be provided and installed by the Control Contractor.

B. RELATED WORK SPECIFIED IN OTHER DIVISIONS

1. Division 16, Electrical:

a. Providing motor starters and disconnect switches (unless otherwise noted).
b. Power wiring and conduit (unless otherwise noted).

1.8 SUBMITTAL

A. Six copies of shop drawings of the control system upgrade shall be submitted and shall consist of a complete list of new equipment and materials, including manufacturers catalog data sheets and installation instructions. Shop drawings shall also contain new and existing wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation as well as a hard copy graphical depiction of the application control programs shall also be included with the submittal package.

B. Submittal shall also include a complete point list of all new and existing connected points to the existing DDC system.

C. Upon completion of the work, provide a complete set of ‘as-built’ drawings and application software on compact disk or removable flash drive. Drawings shall be provided as AutoCAD™ compatible files. Three hard copies of the ‘as-built’ drawings shall be provided in addition to the electronic documents.

1.9 QUALITY ASSURANCE

A. The Manufacturer of the FMCS digital controllers shall provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing). Product literature provided by the FMCS digital controller manufacturer shall contain the ISO-9001 Certification Mark from the applicable registrar, if not already provided.

1.10 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

ASCU	Application Specific Control Unit
BACnet	Building Automation Control Network
BI	BACnet International Organization
BIBB	BACnet Interoperability Building Block
BTL	BACnet Test Laboratory
DDC	Direct Digital Controls
FMCS	Facility Management and Control System
GUI	Graphical User Interface
IBC	Interoperable BACnet Controller
IDC	Interoperable Digital Controller
LAN	Local Area Network
HMI	Human Machine Interface
NAC	Network Area Controller (JACE)
OOT	Object Oriented Technology
PCU	Programmable Control Unit
PICS	Protocol Implementation Conformance Statement
PMI	Power Measurement Interface
POT	Portable Operator's Terminal
WAN	Wide Area Network
WBI	Web Browser Interface

PART 2 - MATERIALS

2.1 GENERAL

A. The Facility Management Control System (FMCS) is existing and will be upgraded.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

A. Physical connection of BACnet devices shall be via Ethernet utilizing BACnet over IP.

B. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

2.3 NETWORKS

A. The Local Area Network (LAN) is existing.

2.4 NETWORK ACCESS

A. Remote Access.

1. For Local Area Network installations, provide access to the LAN from a remote location, via the Internet if required. The owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Owner agrees to provide the network connection and ISP.

2.5 NETWORK AREA CONTROLLER (NAC)

A. The existing Network Area Controller (NAC) provides the interface between the LAN or WAN and the field control devices, and provides global supervisory control functions over the control devices connected to the NAC.

2.6 SYSTEM PROGRAMMING

A. The existing Graphical User Interface software (GUI) provides the ability to perform system programming and graphic display engineering as part of a complete, single software package for configuration and programming of NAC's(Embeded Programming Software) and all data points.

B. The existing library of control, application, and graphic objects provids the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use.

2.7 OTHER CONTROL SYSTEM HARDWARE

A. Control Valves: Provide new 2-way electronic Control valves on the HWR piping to each boiler.

B. Outside Air Temperature Sensors: 10,000-ohm thermistor temperature sensors with an accuracy of ± 0.2ºC. Outside air sensors shall include an integral sun shield. Remove and replace existing outside air temperature sensor.

C. Boiler HWS flow switch.

D. Temperate sensor and transmitters.

E. Controllers.

F. Gas meter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer or its exclusive factory authorized installing contracting field office (representative). The installing office shall have a minimum of five years of installation experience with the manufacturer and shall provide documentation in submittal package verifying longevity of the installing company's relationship with the manufacturer. Supervision, calibration and checkout of the system shall be by the employees of the local exclusive factory authorized temperature control contracting field office (branch or representative).

B. Install existing system upgrade materials in accordance with manufacturer's instructions.

C. Any apparatus not shown, such as relays, accessories, etc., but required to make the system operative to the complete satisfaction of the Engineer shall be furnished and installed without additional cost.

D. Line and low voltage electrical connections to control equipment specified or shown on the control diagrams shall be furnished and installed by the Temperature Control sub-contractor in accordance with these specifications.

E. Equipment furnished by the HVAC Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Temperature Control sub-contractor.

F. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

3.2 WIRING

A. All electrical control wiring and power wiring to the control panels shall be the responsibility of the FMCS contractor.

B. The electrical contractor (Div. 16) shall furnish all power wiring to electrical starters and motors.

C. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All FMCS wiring shall be installed in the conduit types specified in the Project Electrical Specifications (Division 16) unless otherwise allowed by the National Electrical Code or applicable local codes.

3.3 WARRANTY

A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

B. Within this period, upon notice by the Owner, any defects in the FMCS due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the Temperature Control sub-contractor at no expense to the Owner

3.4 WARRANTY ACCESS

A. The Owner shall grant to the Temperature Control sub-contractor, reasonable access to the FMCS during the warranty period. The owner shall allow the contractor to access the FMCS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

3.5 ACCEPTANCE TESTING

A. Upon completion of the installation, the Temperature Control sub-contractor shall load all system software and start-up the system. The Temperature Control sub-contractor shall perform all necessary calibration, testing and de-bugging and

perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

B. The Temperature Control sub-contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.

C. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

D. System Acceptance: Satisfactory completion is when the Temperature Control sub-contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner’s Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.6 OPERATOR INSTRUCTION, TRAINING

A. During system commissioning and at such time acceptable performance of the FMCS hardware and software has been established the Temperature Control sub-contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

B. The Temperature Control sub-contractor shall provide 10 hours of instruction to the owner's designated personnel on the operation of the FMCS and describe its intended use with respect to the programmed functions specified. Operator orientation of the FMCS shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.

C. The training shall be in three formal sessions as follows:

1. Initial Training: One day session (4 hours) after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the owners' personnel can start to familiarize themselves with the system before classroom instruction begins.

2. Follow up training: Within 90 days of substantial completion, provide an additional 4 hours of on site training for owner's designated staff.

3. 1 Year Follow up training: Approximately 1 year after substantial completion, provide another 2 hour training session for owner's designated staff.

PART 4 - SEQUENCES OF OPERATION

4.1 SUMMARY

A. See section 15940 for Sequence of Operation.

PART 5 - POINT LISTS

5.1 SUMMARY

A. The points in the following table shall be accessible from the Graphical User Interface (GUI) and/or the Web browser interface (WBI). The supplier of the IDC and IBC devices shall ensure that the points listed in this table are accessible on their respective networks, by the Network Area Controller (NAC).

B. The following abbreviations apply to the point table to indicate what level of functionality must be provided:

1. D = Display only
2. M = Modify value
3. A = Alarm
4. L = Log
5. S = Schedule
6. GC = Global supervisory control routine such as demand limiting

System	**Mechanical Room Pumps And Boilers**			
Point	**A**	**DI**	**AO**	**DO**
Do P-9 Pump Enable				X
DI P-9 Pump Status		X		
Do P-10 Pump Enable				X
DI P-10 Pump Status		X		
DO P-9 Start/Stop				X
DI P-9 Status		X		
DI P-9 Alarm		X		
DO P-10 Start/Stop				X
DI P-10 Status		X		
DI P-10 Alarm		X		
Do Boiler 1 Enable				X
DI Boiler 1 Status		X		
Do Boiler 2 Enable				X

DI Boiler 2 Status		X		
AO 6” 2 way Valve B1			X	
AO 6” 2 way Valve B2			X	
DI Flow Switch B1		X		
DI Flow Switch B2		X		
UI Return Water Temp B1	X			
UI Supply Water Temp B1	X			
UI Return Water Temp B2	X			
UI Supply Water Temp B2	X			
UI Supply Water Temp CP’s	X			
UI Supply Water Temp Boilers	X			
UI Supply Water Temp System	X			
U IReturn Water Temp System	X			
UI Outside Air Temp	X			

END OF SECTION 15900

SECTION 15940 - SEQUENCE OF OPERATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the control sequence for the Dixie State University Burns Arena Boiler Replacement located in St. George, UT.

1.2 DEFINITIONS

A. DDC: Direct digital control.

B. VFD: Variable frequency drive.

1.3 CENTRAL HIGH TEMP WATER EQUIPMENT SEQUENCES

A. Heating Hot Water System Sequence:

1. The Heating Hot Water System shall be enabled when remote contact closure, the DDC building management system software command is enabled, or the outside air temperature drops below a set point of 75 degrees, adjustable. When the Heating Hot Water System is enabled the heating water pumps, boilers, and automatic valves shall operate according to their listed sequences.

B. Boiler Sequence

1. The Heating Hot Water plant located at The Burns Arena Center at Dixie State University shall be comprised of two central hot water boilers. Boilers shall operate in a lead/lag alternating or combined run time sequence, unless a manual over ride demand sequence is enabled. Boiler operator shall have the ability to over-ride each boiler (which shall include the necessary boiler accessory components such as isolation valves) through both a physical manual override and a software override. The Lead Boiler shall be enabled when the Hot Water System is enabled, and there is a status of a boiler water pump with proof of flow, and the boiler isolation valve prove open, then the Lead boiler shall delay start for 60 seconds to give pumps time to ramp to needed GPM for boiler startup.

2. The Boilers shall operate in a Lead/Lag alternating run time sequence. In normal operation, the lead boiler shall alternate every Tuesday at 10:00 am (adj) and shall overlap and operate together for 120 seconds until switch over is made. Failure alarm of the Lead boiler shall be based on the boiler alarm contact that is part of the boiler control system. After this condition has been maintained for 60 seconds adj, the Lag boiler shall be enabled. Upon the return of the normal

condition of the Lead boiler, where both status and alarm have returned to normal, there shall be an overlap condition where both boilers shall run for 120 seconds and the Lead boiler shall revert back to the Lag boiler and be disabled. The Lag boiler shall revert back the Lead boiler and continue to operate.

3. Boiler plant shall operate to maintain the following adjustable HWS re-set schedule:

OAT = 20 degrees F	HWS = 180-340 degrees F
OAT = 70 degrees F and above	HWS = 150 degrees F

HWS set point shall have an optional physical and software manual override capability.

4. It is anticipated that 1 boiler shall run with the second boiler on stand-by. Lag boiler shall be enabled upon failure alarm from lead boiler, or if lead boiler fails to maintain heating load. This shall be determined if HWS is more than 5 degrees (adj.) less than HWS set point, and HWR is more than 95 degrees (adj.) less than HWS set point. Upon the rise of HWR temp to 75 degrees (adj.) less than HWS set point, the Lag boiler shall be disabled and the Lead boiler shall continue as previously stated. At times both the two boilers may be required to operate simultaneously. During these times, the controls shall be programmed to bring on the second stage boiler per the same sequence as the first stage boiler.

C. Boiler Hot water pumps P-9 and P10:

1. The existing boiler hot water pumps P-9 and P10 are manifolded together so that any one pump can run with any boiler. Upon enabling the Heating Hot Water system, based on the Heating Hot Water System Sequence, the associated pumps shall operate. One circulating pump shall be enabled and prove status for each stage of boilers enabled. For example, 1 pump shall be enabled for 1 boiler, 2 pumps for 2 boilers. Failure of a Lead pump shall be based on failed pump status and lack of flow. After this condition has been maintained for 30 seconds adj, a Lag pump shall be enabled. Upon the return of the normal condition of the Lead pump, where both status and flow are sensed, there shall be an overlap condition where both pumps shall run for 120 seconds and the Lead pump shall become the Lag pump and be disabled. And the Lag pump shall become the Lead pump and continue to operate.
2. Each boiler shall be equipped with an automatic 2-way control valve located on the HWR piping at the boiler. When enabled, the control valve shall be commanded open and shall maintain constant circulating flow through the boiler.
3. When the manual over-ride demand sequence is enabled per boiler, the associated automatic control valve shall be opened and a pump shall be enabled.
4. Control valve shall close when the boiler is disabled.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 15940

SECTION 15950 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes TAB to produce design objectives for the following:

1. Hydronic Piping Systems:

   a. Constant-flow systems.

2. HVAC equipment quantitative-performance settings.
3. Existing systems TAB.
4. Verifying that automatic control devices are functioning properly.
5. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

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

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. NC: Noise criteria.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. TAB: Testing, adjusting, and balancing.

J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

K. Test: A procedure to determine quantitative performance of systems or equipment.

L. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

A. Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

C. Sample Report Forms: Submit two sets of sample TAB report forms.

D. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.

B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems” or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

D. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

F. Approved TAB agencies:

1. Bonneville Test and Balance.
2. BTC Services.
3. Certified Test and Balance.
4. Mechanical Testing Corporation.
5. Intermountain Test and Balance.
6. RS Analysis.
7. Testing and Balancing, Inc.

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, controls installers, and other mechanics to operate systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS
(Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
2. Verify that balancing devices, are required by the Contract Documents. Verify that locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of systems and equipment.

C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."

D. Examine design data, including system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about system and equipment controls.

E. Examine boiler performance data including existing pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of equipment when installed under conditions different from those presented when the equipment was performance tested at the factory.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

I. Examine strainers for clean screens and proper perforations.

J. Examine existing system pumps to ensure absence of entrained air in the suction piping.

K. Examine equipment for installation and for properly operating safety interlocks and controls.

L. Examine automatic temperature system components to verify the following:

1. Valves, and other controlled devices are operated by the intended controller.
2. Valves are in the position indicated by the controller.
3. Integrity of valves for free and full operation and for tightness of fully closed and fully open positions.
4. Automatic modulating and shutoff valves, including two-way valves are properly connected.
5. Sequence of operation for control modes is according to the Contract Documents.
6. Controller set points are set at indicated values.
7. Interlocked systems are operating.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Isolating and balancing valves are open and control valves are operational.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including valve position indicators, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data at pump.

B. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set system controls so automatic valves are wide open to boilers.
6. Check existing pump-motor loads. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
7. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.5 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at existing pumps. Use the following procedures:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.
5. Information on pumps can be obtained from DSU O&M’s.

B. Set existing calibrated balancing valves, at calculated presettings.

C. Measure flow at pump balancing station and set existing balancing device to achieve flow that is 5 percent greater than indicated flow.

D. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

3.6 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.7 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering and leaving- water temperatures and water flow.

3.8 TOLERANCES

A. Set system water flow rates within the following tolerances:

1. Heating-Water Flow Rate: 0 to minus 10 percent.

3.9 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. Provide final report on standard AABC or NEBB forms.

D. Hot Water Boilers: In addition to manufacturer's factory startup equipment reports, include the following:

1. Boiler Data:

a. Boiler identification.
b. Make and type.
c. Model number and unit size.
d. Manufacturer's serial number.
e. Fuel type in input data.
f. Output capacity in Btu/h.
g. Ignition type.
h. Burner-control types.
i. Blower Motor horsepower and rpm.
j. Motor volts, phase, and hertz.
k. Motor full-load amperage and service factor.

E. Existing Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Pump identification.
b. Service.
c. Make and size.
d. Model number and serial number.
e. Water flow rate in gpm.
f. Water pressure differential in feet of head or psig.
g. Required net positive suction head in feet of head or psig.
h. Pump rpm.
i. Impeller diameter in inches.
j. Motor make and frame size.
k. Motor horsepower and rpm.
l. Voltage at each connection.
m. Amperage for each phase.
n. Full-load amperage and service factor.
o. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

3.10 ADDITIONAL TEST

A. Seasonal Periods: I initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 15950

DIVISION 15
ELECTRICAL

16051 COMMON WORK RESULTS FOR ELECTRICAL

SECTION 16051 - COMMON WORK RESULTS FOR ELECTRICAL PERFORMANCE SPECIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

B. Provide design build electrical portion of work. All electrical work shall comply with current codes, and DFCM standards. Provide all electrical work required for a fully functional system upon completion.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: All electrical components.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate with all other trades.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants."

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

END OF SECTION 16051