

**SECTION 00 0101
PROJECT TITLE PAGE**

PROJECT MANUAL

FOR

WATERTOWN DPW BOILER REPLACEMENT

OWNER'S PROJECT NUMBER: 210154

WATERTOWN DEPARTMENT OF PUBLIC WORKS (DPW)

**124 ORCHARD STREET
WATERTOWN, MA 02472**

DATE: 09/08/2022

PREPARED BY:

B2Q ASSOCIATES

END OF SECTION

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**SECTION 00 2113
INSTRUCTIONS TO BIDDERS**

INVITATION

1.01 BID SUBMISSION

- A. Submit bids as hard copy to the Purchasing Office located at 143 Main Street, Watertown, MA 02472.
- B. Comply with Owner's Bid requirements and procedures.

END OF SECTION

**SECTION 00 5200
AGREEMENT FORM**

PART 1 GENERAL

1.01 FORM OF AGREEMENT

1.02 THE AGREEMENT TO BE EXECUTED IS ATTACHED FOLLOWING THIS PAGE.

1.03 RELATED REQUIREMENTS

- A. Section 00 7300 - Supplementary Conditions.
- B. Section 01 4216 - Definitions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 1000
SUMMARY**

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: Watertown DPW Boiler Replacement
- B. Owner's Name: Watertown Department of Public Works (DPW).
- C. Engineer's Name: B2Q Associates.

1.02 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 5200 - Agreement Form.

1.03 DESCRIPTION OF PROJECT WORK

- A. Scope of demolition and removal work is indicated on drawings and specified in Section 02 4100.
- B. Scope of alterations work is indicated on drawings.
- C. Renovate the following areas, complete including operational mechanical work and finishes. Electrical work by owner.:
- D. HVAC: Alter existing system and add new construction, keeping existing in operation.

1.04 WORK BY OWNER

- A. Owner will supply and install the following:
 - 1. Two (2) new 3/4-HP motors for existing Pumps P-5&6.
- B. Owner will supply the following for installation by Contractor:
 - 1. Two (2) Patterson-Kelley ST-1500 P-K Storm Hot Water Condensing Boilers.

1.05 OWNER OCCUPANCY

- A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
- B. Owner intends to occupy the Project upon Substantial Completion.
- C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- D. Schedule the Work to accommodate Owner occupancy.

1.06 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
 - 1. Locate and conduct construction activities in ways that will limit disturbance to site.
- B. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- C. Utility Outages and Shutdown:
 - 1. Prevent accidental disruption of utility services to other facilities.

1.07 WORK SEQUENCE

- A. Coordinate construction schedule and operations with Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

- A. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.
- B. Section 01 6000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.03 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
 - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
 - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
- C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 - 1. No specific form is required. Contractor's Substitution Request documentation must include the following:
 - a. Project Information:
 - b. Substitution Request Information:
 - 1) Differences between proposed substitution and specified item.
 - 2) Description of how proposed substitution affects other parts of work.
 - c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
 - 1) Physical characteristics.
 - 2) In-service performance.
 - 3) Warranties.
 - 4) Other salient features and requirements.
 - d. Impact of Substitution:
 - 1) Savings to Owner for accepting substitution.
 - 2) Change to Contract Time due to accepting substitution.
- D. Limit each request to a single proposed substitution item.

1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 RESOLUTION

- A. Engineer will notify Contractor in writing of decision to accept or reject request.

3.03 ACCEPTANCE

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

END OF SECTION

SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General administrative requirements.
- B. Preconstruction meeting.
- C. Site mobilization meeting.
- D. Progress meetings.
- E. Construction progress schedule.
- F. Coordination drawings.
- G. Submittals for review, information, and project closeout.
- H. Number of copies of submittals.
- I. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.
- B. Section 01 9113 - General Commissioning Requirements: Submit submittals to both Engineer and Commissioning Agent for review.
 - 1. Where submittals are indicated for review by both Engineer and the Commissioning Authority, submit one extra and route to Engineer first, for forwarding to the Commissioning Authority.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 01 7000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B. Make the following types of submittals to Engineer:
 - 1. Requests for Interpretation (RFI).
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Design data.
 - 6. Manufacturer's instructions and field reports.
 - 7. Progress schedules.
 - 8. Coordination drawings.
 - 9. Correction Punch List and Final Correction Punch List for Substantial Completion.
 - 10. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING

- A. Owner will schedule a meeting after Notice of Award.
- B. Attendance Required:
 - 1. Owner.
 - 2. Engineer.
 - 3. Contractor.
- C. Record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer, Owner, participants, and those affected by decisions made.

3.02 SITE MOBILIZATION MEETING

- A. Schedule meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:
 - 1. Contractor.
 - 2. Owner.
 - 3. Contractor's superintendent.
 - 4. Major subcontractors.
- C. Agenda:
 - 1. Use of premises by Owner and Contractor.
 - 2. Owner's requirements.
 - 3. Construction facilities and controls provided by Owner.
 - 4. Temporary utilities provided by Owner.
 - 5. Survey and building layout.
 - 6. Security and housekeeping procedures.
 - 7. Schedules.
 - 8. Application for payment procedures.
 - 9. Procedures for testing.
 - 10. Procedures for maintaining record documents.
 - 11. Requirements for start-up of equipment.
 - 12. Inspection and acceptance of equipment put into service during construction period.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the work at maximum weekly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required:
 - 1. Contractor.
 - 2. Owner.
 - 3. Contractor's superintendent.
 - 4. Major subcontractors.
- D. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems that impede, or will impede, planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Review of RFIs log and status of responses.
 - 7. Maintenance of progress schedule.
 - 8. Corrective measures to regain projected schedules.
 - 9. Planned progress during succeeding work period.
 - 10. Maintenance of quality and work standards.
 - 11. Effect of proposed changes on progress schedule and coordination.
 - 12. Other business relating to work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.

- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

3.05 COORDINATION DRAWINGS

- A. Provide information required by Project Coordinator for preparation of coordination drawings.
- B. Review drawings prior to submission to Engineer.

3.06 REQUESTS FOR INTERPRETATION (RFI)

- A. Definition: A request seeking one of the following:
 - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 - 2. A resolution to an issue which has arisen due to field conditions and affects design intent.

3.07 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 - 1. Product data.
 - 2. Shop drawings.
 - 3. Owner's training plan.
- B. Submit to Engineer for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below .

3.08 SUBMITTALS FOR INFORMATION

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

3.09 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Final Correction Punch List for Substantial Completion.
- B. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
- C. Submit for Owner's benefit during and after project completion.

3.10 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Extra Copies at Project Closeout: See Section 01 7800.

3.11 SUBMITTAL PROCEDURES

- A. General Requirements:
 - 1. Use a separate transmittal for each item.
 - 2. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - 3. When revised for resubmission, identify all changes made since previous submission.

4. Call out specific model numbers, options, ordering information, etc. from general catalog lists.

3.12 SUBMITTAL REVIEW

- A. Submittals for Review: Engineer will review each submittal, and approve, or take other appropriate action.
- B. Engineer's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
- C. Engineer's and consultants' actions on items submitted for review:
 1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Approved", or language with same legal meaning.
 - b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
 - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
 - c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
 - 1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
 2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit".
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.
 - b. "Rejected".
 - 1) Submit item complying with requirements of Contract Documents.
- D. Engineer's and consultants' actions on items submitted for information:
 1. Items for which no action was taken:
 - a. "Received" - to notify the Contractor that the submittal has been received for record only.
 2. Items for which action was taken:
 - a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

SECTION 01 4216

DEFINITIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

- A. Furnish: To supply, deliver, unload, and inspect for damage.
- B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- D. Provide: To furnish and install.
- E. Supply: Same as Furnish.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 6000
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Re-use of existing products.
- B. Transportation, handling, storage and protection.
- C. Substitution limitations.
- D. Procedures for Owner-supplied products.
- E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

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

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.

2.03 MAINTENANCE MATERIALS

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

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. See Section 01 2500 - Substitution Procedures.
- B. Engineer will consider requests for substitutions only within 15 days after date established in Notice to Proceed.

3.02 OWNER-SUPPLIED PRODUCTS

- A. See Section 01 1000 - Summary for identification of Owner-supplied products.
- B. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 - 2. Arrange and pay for product delivery to site.
 - 3. On delivery, inspect products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for manufacturers' warranties, inspections, and service.

- C. Contractor's Responsibilities:
 - 1. Review Owner reviewed shop drawings, product data, and samples.
 - 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 - 3. Handle, store, install and finish products.
 - 4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.
- I. All ductwork and piping materials shall be protected from dust and debris from point of fabrication until final acceptance.

3.04 STORAGE AND PROTECTION

- A. Provide protection of stored materials and products against theft, casualty, or deterioration.
- B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 7419.
- C. Store and protect products in accordance with manufacturers' instructions.
- D. Store with seals and labels intact and legible.
- E. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- F. For exterior storage of fabricated products, place on sloped supports above ground.
- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- H. Comply with manufacturer's warranty conditions, if any.
- I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- J. Prevent contact with material that may cause corrosion, discoloration, or staining.
- K. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- L. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
- M. All ductwork and piping materials shall be protected from dust and debris from point of fabrication until final acceptance.

END OF SECTION

SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.

1.03 REFERENCE STANDARDS

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.05 QUALIFICATIONS

- A. For demolition work, employ a firm specializing in the type of work required.

1.06 PROJECT CONDITIONS

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

1.07 COORDINATION

- A. See Section 01 1000 for occupancy-related requirements.
- B. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean-up of work of separate sections.

- F. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 GENERAL INSTALLATION REQUIREMENTS

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

3.04 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Engineer before disturbing existing installation.
 - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
 - 1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.

2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- C. Remove existing work as indicated and as required to accomplish new work.
1. Remove items indicated on drawings.
 2. Relocate items indicated on drawings.
 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- D. Services (Including but not limited to HVAC, Plumbing, and Electrical): Remove, relocate, and extend existing systems to accommodate new construction.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. Provide temporary connections as required to maintain existing systems in service.
 4. Verify that abandoned services serve only abandoned facilities.
- E. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
- F. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
- G. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- H. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- I. Clean existing systems and equipment.
- J. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- K. Do not begin new construction in alterations areas before demolition is complete.
- L. Comply with all other applicable requirements of this section.

3.05 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
 1. Complete the work.
 2. Fit products together to integrate with other work.

3. Provide openings for penetration of mechanical, electrical, and other services.
 4. Match work that has been cut to adjacent work.
 5. Repair areas adjacent to cuts to required condition.
 6. Repair new work damaged by subsequent work.
 7. Remove samples of installed work for testing when requested.
 8. Remove and replace defective and non-complying work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material , to full thickness of the penetrated element.
- J. Patching:
1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 2. Match color, texture, and appearance.
 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.06 PROGRESS CLEANING

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

3.07 PROTECTION OF INSTALLED WORK

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

3.08 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Engineer and Owner seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.09 COMMISSIONING

- A. Commissioning submittals:
 - 1. System O&M Manual
 - a. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents.
 - b. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
 - c. Control equipment component submittals, parts lists, etc.
 - d. Warranty requirements.
 - e. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
 - 2. Startup and Pre-Functional Test Reports
- B. Perform and document all manufacturers' recommended start up procedures.
- C. Document the results of all pre-functional tests and start up procedures.
- D. Address punch list items resulting from the pre-functional and startup testing.
- E. Retest, as needed, to verify that punch list items have been resolved.
- F. Functionally test standalone controls including any interlocks with other equipment or systems.
- G. TAB Coordination
 - 1. TAB: Testing, adjusting, and balancing of HVAC.
 - 2. Coordinate commissioning schedule with TAB schedule.
 - 3. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
 - 4. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.
 - 5. Have all required Prefunctional Checklists, calibrations, and Startup Tests of the system completed and approved by the Engineer prior to starting TAB.
- H. Demonstrate to the Engineer:
 - 1. That all specified functions and features are set up, debugged and fully operable.
 - 2. That all graphic screens and value readouts are completed.
 - 3. Correct date and time setting in central computer.
 - 4. Global commands features.
 - 5. Security and access codes.
 - 6. Occupant over-rides (manual, telephone, key, keypad, etc.).
 - 7. O&M schedules and alarms.
 - 8. That points that are monitored only, having no control function, are reporting properly to the control system.

3.10 DEMONSTRATION AND INSTRUCTION

- A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

- B. Demonstrate operation and maintenance of HVAC system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. These demonstrations are not a substitute for commissioning.
- E. Provide minimum duration of training: 4 hours.
- F. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.
- G. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- H. Provide the services of manufacturer representatives to assist instructors where necessary.

3.11 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.
- B. Testing, adjusting, and balancing HVAC systems: See Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.

3.12 FINAL CLEANING

- A. Use cleaning materials that are nonhazardous.
- B. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- C. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- D. Clean filters of operating equipment.
- E. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.13 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 1. Provide copies to Engineer and Owner.
- B. Notify Engineer when work is considered ready for Engineer's Substantial Completion inspection.
- C. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Engineer's Substantial Completion inspection.
- D. Conduct Substantial Completion inspection and create Final Correction Punch List containing Engineer's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Engineer.
- E. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- F. Notify Engineer when work is considered finally complete and ready for Engineer's Substantial Completion final inspection.
- G. Complete items of work determined by Engineer listed in executed Certificate of Substantial Completion.

END OF SECTION

**SECTION 01 7800
CLOSEOUT SUBMITTALS**

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.
- C. Individual Product Sections: Specific requirements for operation and maintenance data.
- D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Engineer and Owner.
- B. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Engineer comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

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

3.02 OPERATION AND MAINTENANCE DATA

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

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
 - 1. Product data, with catalog number, size, composition, and color and texture designations.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional information as specified in individual product specification sections.
- E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. Provide servicing and lubrication schedule, list of lubricants required, and calibration schedule.
- G. Include manufacturer's printed operation and maintenance instructions.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Provide control diagrams by controls manufacturer as installed.
- K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

- M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- N. Include test and balancing reports.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Engineer, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

3.06 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.

END OF SECTION

SECTION 23 0519
METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pressure gauges and pressure gauge taps.
- B. Thermometers and thermometer wells.

1.02 RELATED REQUIREMENTS

- A. Section 23 2113 - Hydronic Piping.

1.03 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014, with Editorial Revision (2017).
- D. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.05 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com.
 - 2. Moeller Instrument Company, Inc: www.moellerinstrument.com.
 - 3. Omega Engineering, Inc: www.omega.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Steel with brass bourdon tube.
 - 2. Size: 4 inch diameter.
 - 3. Mid-Scale Accuracy: One percent.
 - 4. Scale: Psi and KPa.

2.02 PRESSURE GAUGE TAPPINGS

- A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.

2.03 STEM TYPE THERMOMETERS

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com.
 - 2. Omega Engineering, Inc: www.omega.com.
 - 3. Weksler Glass Thermometer Corp: www.wekslerglass.com.
- B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
 - 1. Size: 9 inch scale.

2. Window: Clear Lexan.
3. Stem: 3/4 inch NPT brass.
4. Accuracy: 2 percent, per ASTM E77.
5. Calibration: Degrees F.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide pressure gauges and thermometers as-indicated on the drawings.
- C. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- D. Coil and conceal excess capillary on remote element instruments.
- E. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- F. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- G. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- H. Locate test plugs adjacent thermometers and thermometer sockets.

END OF SECTION

SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2007.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Boiler: Nameplates.
- B. Control Panels: Nameplates.
- C. Instrumentation: Tags.
- D. Major Control Components: Nameplates.
- E. Piping: Pipe markers.
- F. Pumps: Nameplates.
- G. Valves:Tags.

2.02 NAMEPLATES

- A. Manufacturers:
 - 1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com.
 - 2. Brimar Industries, Inc.: www.pipemarker.com.
 - 3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 - 4. Seton Identification Products, a Tricor Direct Company: www.seton.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

2.03 TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
 - 2. Brady Corporation: www.bradycorp.com.
 - 3. Brimar Industries, Inc.: www.pipemarker.com.
 - 4. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 - 5. Seton Identification Products, a Tricor Company: www.seton.com.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 PIPE MARKERS

- A. Manufacturers:

1. Brady Corporation: www.bradycorp.com.
 2. Brimar Industries, Inc.: www.pipemarker.com.
 3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
 4. MIFAB, Inc.: www.mifab.com.
 5. Seton Identification Products, a Tricor Company: www.seton.com.
 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

END OF SECTION

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of hydronic systems.

1.02 REFERENCE STANDARDS

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

1.03 SUBMITTALS

- A. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- B. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Submit to the Commissioning Authority within two weeks after completion of testing, adjusting, and balancing.
 - 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer and for inclusion in operating and maintenance manuals.
 - 4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 6. Units of Measure: Report data in I-P (inch-pound) units only.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform testing and balancing in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards.
 - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 3. SMACNA (TAB).
- B. Pre-installation test shall be performed before construction. Post-installation testing and balancing shall begin after completion of systems to be tested, adjusted, or balanced and be completed prior to Substantial Completion of the project.
- C. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
 - b. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

- D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Hydronic systems are flushed, filled, and vented.
 - 5. Pumps are rotating correctly.
 - 6. Proper strainer baskets are clean and in place.
 - 7. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of post-installation work means acceptance of existing conditions.

3.03 PREPARATION

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

3.04 ADJUSTMENT TOLERANCES

- A. Hydronic Systems: Adjust to within plus or minus 5 percent of design.

3.05 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.
 - 3. Contract interpretation requests.
 - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.06 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Field determine minimum pump speed for P-3 and P-4.
- E. Effect system balance with automatic control valves fully open to heat transfer elements.

3.07 SCOPE

- A. The following equipment shall be tested pre-installation and post-installation. Pumps to remain shall be rebalanced to pre-installation flows.
 - 1. B-1 and B-2
 - 2. Boiler header piping
 - 3. Pumps 1-6

4. New manual bypass (post-installation only)

END OF SECTION

**SECTION 23 0719
HVAC PIPING INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.

1.02 RELATED REQUIREMENTS

- A. Section 23 2113 - Hydronic Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.
- B. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2013.
- C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 5 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

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

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. K Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 1200 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

3. Secure with pressure sensitive tape.
- D. Tie Wire: Annealed steel, 16 gage, 0.0508 inch diameter.

2.03 JACKETS

- A. PVC Plastic (On all interior piping).
 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 30 mil.
 - e. Connections: Brush on welding adhesive.
 2. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
 - a. Lagging Adhesive: Compatible with insulation.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- E. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
 1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- F. Inserts and Shields:
 1. Application: Piping 1-1/2 inches diameter or larger.
 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 3. Insert location: Between support shield and piping and under the finish jacket.
 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- G. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

END OF SECTION

SECTION 23 1123
FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe, pipe fittings, valves, and connections for natural gas piping systems.

1.02 REFERENCE STANDARDS

- A. NFPA 54
- B. CMR 248 Massachusetts Fuel Gas Code
- C. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators; 2007 (Reaffirmed 2016).
- D. ANSI Z21.80/CSA 6.22 - Line Pressure Regulators; 2011 (Addendum A, 2012).
- E. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
- F. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2011.
- G. ASME B31.1 - Power Piping; 2016.
- H. ASME B31.9 - Building Services Piping; 2014.
- I. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2015.
- K. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; 2011.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, and ASTM specification.

1.05 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Threaded or welded to ASME B31.1.
 - 3. Mechanical Press Sealed Fittings: Double pressed type and approved or certified, utilizing EPDM, non toxic synthetic rubber sealing elements.

2.02 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 Inches and Under:
 - 1. Ferrous Pipe: Class 150 malleable iron threaded unions.
- B. Flanges for Pipe Size Over 1 Inch:
 - 1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.03 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 - 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 - 4. Vertical Pipe Support: Steel riser clamp.
 - 5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.

2.04 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

- A. Compliance Requirements:
 - 1. Appliance Regulator: ANSI Z21.18/CSA 6.3.
- B. Materials in Contact With Gas:
 - 1. Housing: Aluminum, steel (free of non-ferrous metals).
 - 2. Seals and Diaphragms: NBR-based rubber.
- C. Maximum Inlet Operating Pressure: 10 psi.
 - 1. Appliance Regulator: 10 psi.
- D. Maximum Body Pressure: 10 psi.
- E. Output Pressure Range: 7 inch wc to 14 inch wc.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- G. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
- H. Install valves with stems upright or horizontal, not inverted.
- I. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

- J. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Support horizontal piping as indicated.
 - 3. Place hangers within 12 inches of each horizontal elbow.
 - 4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.04 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Provide plug valves in natural gas systems for shut-off service.
- C. Provide regulator at each boiler.

END OF SECTION

**SECTION 23 2113
HYDRONIC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Section 23 0553 - Identification for HVAC Piping and Equipment.
- B. Section 23 0719 - HVAC Piping Insulation.
- C. Section 23 2114 - Hydronic Specialties.

1.03 REFERENCE STANDARDS

- A. ANSI/FCI 70-2 - Control Valve Seat Leakage; 2013.
- B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
- C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2011.
- D. ASME B16.15 - Cast Copper Alloy Threaded Fittings Classes 125 and 250; 2013.
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- F. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- G. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.
- H. ASME B31.9 - Building Services Piping; 2014.
- I. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- J. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2014.
- K. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts; 2003 (Reapproved 2009).
- L. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2015.
- M. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- N. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
- O. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
- P. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.
- Q. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2015.

- R. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2013.
- S. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2006.
- T. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2010).
- U. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2008).
- V. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2013).
- W. AWWA C606 - Grooved and Shouldered Joints; 2011.
- X. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

2.02 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
 3. Grooved piping and joints may only be used for temporary piping connected to temporary boiler if Add-Alt #1 is selected. If Add-Alt #1 is not selected then grooved piping and joints are not allowed.
 4. Grooved mechanical joints may be used in accessible locations only.
 - a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Engineer.
 - b. Grooved mechanical connections and joints comply with AWWA C606.
 - 1) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
 - c. Use rigid joints unless otherwise indicated.
 - d. Provide steel coupling nuts and bolts complying with ASTM A183.
 5. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.

- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges or unions to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
 1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.
- D. Valves: Provide valves where indicated:
 1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap.
 2. On discharge of hot water pumps, use spring-loaded check valves.
 3. Isolate equipment using butterfly valves with lug end flanges. or grooved mechanical couplings.
 4. For throttling, bypass, or manual flow control services, use globe valves.
 5. In heating water systems, butterfly valves may be used interchangeably with gate and globe valves.
 6. For shut-off and to isolate parts of systems or vertical risers, use butterfly valves.
- E. Welding Materials and Procedures: Comply with ASME BPVC-IX.

2.03 HEATING WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 2. Threaded Joints: ASME B16.3, malleable iron fittings.
 3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

2.04 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types:
 1. Threaded Joints: Galvanized cast iron, or ASME B16.3 malleable iron fittings.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
- C. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
 1. Fittings: ASTM D2466 or D2467, PVC.
 2. Joints: Solvent welded in accordance with ASTM D2855.

2.05 PIPE HANGERS AND SUPPORTS

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

11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
12. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 6 Inches and Greater: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
14. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
15. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
16. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.06 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe 2 Inches and Less:
 1. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe 2 Inches and Greater:
 1. Ferrous Piping: 150 psig forged steel, slip-on.
 2. Gaskets: 1/16 inch thick, preformed neoprene.
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 1. Dimensions and Testing: In accordance with AWWA C606.
 2. Mechanical Couplings: Comply with ASTM F1476.
 3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
 4. When pipe is field grooved, provide coupling manufacturer's grooving tools.
- D. Dielectric Connections (install to connect dissimilar piping materials):
 1. Waterways:
 - a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
 - b. Dry insulation barrier able to withstand 600-volt breakdown test.
 - c. Construct of galvanized steel with threaded end connections to match connecting piping.
 - d. Suitable for the required operating pressures and temperatures.
 2. Flanges:
 - a. Dielectric flanges with same pressure ratings as standard flanges.
 - b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
 - c. Dry insulation barrier able to withstand 600-volt breakdown test.
 - d. Construct of galvanized steel with threaded end connections to match connecting piping.
 - e. Suitable for the required operating pressures and temperatures.

2.07 BALL VALVES (USE ON 2" AND SMALLER PIPING)

- A. Manufacturers:
 1. Anvil International; _____: www.anvilintl.com/#sle.
 2. Apollo Valves; _____: www.apollovalves.com/#sle.
 3. Grinnell Products; _____: www.grinnell.com/#sle.
 4. Victaulic Company; _____: www.victaulic.com/#sle.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Up To and Including 2 Inches:
 1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.
- C. Over 2 Inches:

1. Ductile iron body, chrome plated stainless steel ball, teflon or Virgin TFE seat and stuffing box seals, lever handle or gear operated, flanged ends, rated to 800 psi.

2.08 BUTTERFLY VALVES (USE ON 2-1/2" AND LARGER PIPING)

- A. Manufacturers:
 1. Anvil International; _____: www.anvilintl.com/#sle.
 2. Apollo Valves; _____: www.apollovalves.com/#sle.
 3. Grinnell Products; _____: www.grinnell.com/#sle.
- B. Body: Cast or ductile iron with resilient replaceable EPDM seat, lug ends, extended neck.
- C. Disc: Construct of aluminum bronze or stainless steel.
- D. Stem: Stainless steel with stem offset from the centerline to provide full 360-degree circumferential setting.
- E. Operator: Handwheel and gear drive.

2.09 SWING CHECK VALVES

- A. Manufacturers:
 1. Anvil International; _____: www.anvilintl.com/#sle.
 2. Apollo Valves; _____: www.apollovalves.com/#sle.
 3. Grinnell Products; _____: www.grinnell.com/#sle.
- B. Up To and Including 2 Inches:
 1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.

2.10 PRESSURE INDEPENDENT TEMPERATURE CONTROL VALVES AND BALANCING VALVES

- A. Manufacturers:
 1. Danfoss; AB-QM Valve: www.danfoss.com/#sle.
 2. Schneider Electric; _____: www.schneider-electric.us/#sle.
 3. Belimo: www.belimo.com..
- B. Control Valves: Factory-fabricated pressure independent with internal differential pressure regulator (DPRV), which automatically adjusts to normal changes in system pressure and provides 100 percent control valve authority at all positions of the valve.
 1. Maintain proportional and linear flow coil characteristics.
 2. PICV to accurately control the flow from 0 to 100 percent full rated flow with an operating pressure differential range of 3 to 60 psig.
 3. Provide ANSI/FCI 70-2 Class 4 shut-off on all sizes and field serviceable.
 4. Provide control valve to incorporate control, balancing, and flow limiting. Hydronic system pressure independent control valve bodies to comply with ASME B16.34 or ASME B16.15 pressure and temperature class ratings based on the design operating temperature and 150 percent of the system design operating pressure and have the following characteristics:
 - a. 2 NPS and Smaller: Class 150 bronze or brass body with union connections, stainless steel trim, stainless steel rising stem, stainless steel disc or ball, and screwed ends with backseating capacity repackable under pressure.
 - b. 2-1/2 NPS and Larger: Class 125 iron or ductile iron body, stainless steel trim, stainless steel rising stem, stainless steel disc or ball, flanged ends with backseating capacity repackable under pressure.
 - c. Pressure Control Seat: Brass construction with vulcanized EPDM.
 - d. Fittings and Components: All fittings and components to meet ANSI standards and be compatible with readily available components. 8-inch valves and above to be provided with proper companion flanges.
 - e. Close-Off (Differential) Pressure Rating: Combination of actuator, DPRV action, and trim to provide a minimum close-off pressure rating of 150 percent of total system (pump) head. Provide actuator from the same manufacturer as the pressure independent control valve.

- C. Electronic Actuators: Direct-mounted, self-calibrating type designed for minimum 60,000 full-stroke cycles at rated force.
- D. Provide actuator with visible position indication. Fail positions on power failure to include in-place, open or closed as indicated in the controls specifications.
 - 1. Valves: Sized for maximum circuit flow rate and nominally, line-sized.
 - 2. Power Requirements (Two-Position Spring Return): 24 VAC.
 - 3. Power Requirements (Modulating): Maximum 10 VA at 24 VAC or 8 watts at 24 VDC.
 - 4. Proportional Signal: 0 to 10 VDC or 2 to 10 VDC or 4 to 20 mA, and 2 to 10 VDC position feedback signal.
 - 5. Temperature Rating: 40 to 104 degrees F.

PART 3 EXECUTION

4.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment using jointing system specified.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps. Clean pipe strainers as necessary to remove debris.
- F. After completion, fill, clean, and treat systems.

4.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9 requirements.
- C. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- D. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- E. Install piping to conserve building space and to avoid interference with use of space.
- F. Group piping whenever practical at common elevations.
- G. Sleeve pipe passing through partitions, walls, and floors.
- H. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified _____.
- I. Slope piping and arrange to drain at low points.
- J. Grooved Joints:
 - 1. Install in accordance with the manufacturer's latest published installation instructions.
 - 2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.
- K. Inserts:
 - 1. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 2. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- L. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.

5. Use hangers with 1-1/2 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 7. Provide copper plated hangers and supports for copper piping.
 8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 0719.
- N. Provide access where valves and fittings are not exposed.
- O. Use eccentric reducers to maintain top of pipe level.
- P. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.
- Q. Install valves with stems upright or horizontal, not inverted.

4.03 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
1. 1/2 Inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 2. 1 Inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 3. 1-1/2 Inches and 2 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 4. 2-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
- B. Hanger Spacing for Steel Piping.
1. 1/2 Inch, 3/4 Inch, and 1 Inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 2. 1-1/4 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 3. 1-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 4. 2 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 5. 2-1/2 Inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 6. 3 Inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 7. 4 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 8. 6 Inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
- C. Hanger Spacing for Plastic Piping.
1. 1/2 Inch: Maximum span, 42 inches; minimum rod size, 1/4 inch.
 2. 3/4 Inch: Maximum span, 45 inches; minimum rod size, 1/4 inch.
 3. 1 Inch: Maximum span, 51 inches; minimum rod size, 1/4 inch.

END OF SECTION

**SECTION 23 2114
HYDRONIC SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air vents.
- B. Balancing valves.
- C. Relief valves.

1.02 RELATED REQUIREMENTS

- A. Section 23 2113 - Hydronic Piping.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 AIR VENTS

- A. Manufacturers:
 - 1. Armstrong International, Inc; _____: www.armstronginternational.com/#sle.
 - 2. ITT Bell & Gossett; _____: www.bellgossett.com/#sle.
 - 3. Taco, Inc; _____: www.taco-hvac.com/#sle.
 - 4. Spirotherm: www.spirotherm.com.
- B. Manual Type: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

2.02 BALANCING VALVES

- A. Manufacturers:
 - 1. Armstrong International, Inc; _____: www.armstronginternational.com/#sle.
 - 2. ITT Bell & Gossett; _____: www.bellgossett.com/#sle.
 - 3. Taco, Inc; _____: www.taco-hvac.com/#sle.
- B. Size 2 inch and Smaller:
 - 1. Provide ball or globe style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded connections.
 - 2. Metal construction materials consist of bronze or brass.
 - 3. Non-metal construction materials consist of Teflon, EPDM, or engineered resin.
- C. Size 2.5 inch and Larger:
 - 1. Provide ball, globe, or Diaphragm style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged connections.
 - 2. Valve body construction materials consist of cast iron, carbon steel, ductile iron, or PVC.
 - 3. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, EPDM, NORYL, or engineered resin.

2.03 RELIEF VALVES

- A. Manufacturers:
 - 1. Apollo Valves; _____: www.apollovalves.com/#sle.
 - 2. Armstrong International, Inc; _____: www.armstronginternational.com/#sle.
 - 3. ITT Bell & Gossett; _____: www.bellgossett.com/#sle.
- B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Where large air quantities can accumulate, provide enlarged air collection standpipes.
- C. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- D. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- E. Where one line vents several relief valves, make cross-sectional area equal to sum of individual vent areas.

END OF SECTION

SECTION 23 5100
BREECHINGS, CHIMNEYS, AND STACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured breechings.

1.02 REFERENCE STANDARDS

- A. ANSI Z21.66 - American National Standard for Automatic Damper Devices for Use with Gas-Fired Appliances; 2015.
- B. 248 CMR Massachusetts Fuel Gas Code
- C. NFPA 54 - National Fuel Gas Code; 2018.
- D. NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment; 2014.
- E. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2016.
- F. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).
- G. UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances; Current Edition, Including All Revisions.

1.03 DEFINITIONS

- A. Breeching: Vent connector.
- B. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.
- C. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.04 DESIGN REQUIREMENTS

- A. Factory built vents and chimneys used for venting natural draft appliances to comply with NFPA 211 and be UL listed and labeled.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. AMPCO by Hart & Cooley, Inc: www.ampcostacks.com/#sle.
- B. DuraVent: www.duravent.com/#sle.
- C. Metal-Fab, Inc; _____: www.mtlfab.com/#sle.
- D. Security Chimneys International: www.securitychimneys.com/#sle.
- E. Selkirk Corporation; Model PS: www.selkirkcommercial.com/#sle.
- F. Z-Flex U.S. Inc; _____: www.z-flex.com/#sle.

2.02 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL REQUIREMENTS

- A. Regulatory Requirements:
 - 1. Comply with applicable codes for installation of natural gas burning appliances and equipment.

2.03 MANUFACTURED BREECHINGS

- A. Provide factory-built, modular connector and manifold system, tested to UL 103 with positive pressure rating.

- B. Assembly to be UL listed for use with building equipment in compliance with NFPA 211.
- C. Fabricate with 1 inch minimum air space between walls and construct inner liner of AL-29-4C and outer jacket of AL-29-4C.
- D. Design, fabricate, and install gas-tight preventing products of combustion leaking into the building.
 - 1. Securely connect inner joints and seal with factory supplied overlapping V-bands and appropriate sealant in accordance with manufacturer's instructions.
 - 2. System design to compensate for all flue gas induced thermal expansion.
- E. Boilers shall come standard with a flue sensor to monitor and display flue gas temperature.
- F. Install per manufacturer's Installation and Operations manual.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 54.
- C. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.
- D. Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA (DCS) for equivalent duct support configuration and size.
- E. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.
- F. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.
- G. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.
- H. Level and plumb chimney and stacks.
- I. Clean breechings, chimneys, and stacks during installation, removing dust and debris.

END OF SECTION

SECTION 23 5216
CONDENSING BOILERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured units.
- B. Boiler construction.
- C. Boiler trim.
- D. Fuel burning system.
- E. Factory installed controls.

1.02 RELATED REQUIREMENTS

- A. Section 23 0913 - Instrumentation and Control Devices for HVAC.
- B. Section 23 2114 - Hydronic Specialties.
- C. Section 23 2123 - Hydronic Pumps.
- D. Section 23 5100 - Breechings, Chimneys, and Stacks.

1.03 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
- B. ANSI Z21.13 - American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers; 2017.
- C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2017.
- E. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); Current Edition.
- F. NFPA 54 - National Fuel Gas Code; 2018.
- G. SCAQMD 1146.1 - Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters; 1990 (Amended 2013).

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
- B. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide a five year warranty to include coverage for heat exchanger.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Natural Gas, Propane, or Combination Natural Gas/Propane for Indoor Applications:
 - 1. Patterson-Kelley, LLC; www.pattersonkelley.com.

2.02 MANUFACTURED UNITS

- A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.
- B. Unit: Metal membrane wall, water or fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for indoor application.

2.03 BOILER CONSTRUCTION

- A. Comply with the minimum requirements of ASME BPVC-IV and ANSI Z21.13 for construction of boilers.
- B. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE Std 90.1.
- C. Required Directory Listings:
 - 1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
 - 2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at www.nationalboard.org.
- D. Heat Exchanger: Construct with materials that are impervious to corrosion where subject to contact with corrosive condensables.
- E. Provide adequate tappings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.
- F. Insulate casing with insulation material, protected and covered by heavy-gage metal jacket.
- G. Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic, powder coated, painted, or weather-proofed finish.

2.04 BOILER TRIM

- A. ASME rated pressure relief valve.
- B. Flow switch.
- C. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.
- D. Temperature and pressure gauge.
- E. Pressure Switches:
 - 1. High gas pressure.
 - 2. Low gas pressure.
 - 3. Air pressure.
- F. Manual reset high limit.
- G. Drain valves with hose end connection.
- H. Condensate trap with condensate trip sensor.

2.05 FUEL BURNING SYSTEM

- A. Provide forced draft automatic burner, integral to boiler, designed to burn natural gas, and maintain fuel-air ratios automatically.
 - 1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.
 - 2. Forced Draft Design: Mixes combustion air and gas to achieve 90 percent combustion efficiency.

3. Combustion Air Filter: Protects fuel burning system from debris.
- B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture. Gas train shall be capable of 10:1 turndown.
- C. Emission of Oxides of Nitrogen Requirements: Comply with SCAQMD 1146.1 for natural gas fired system, as applicable.
- D. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe.

2.06 FACTORY INSTALLED CONTROLS

- A. Option for internal or external (0-10) VDC control.
- B. Temperature Controls:
 1. Automatic reset type to control fuel burning system on-off to maintain temperature.
 2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.
 3. Low-fire start time delay relay.
- C. Electronic PI setpoint/modulation control system.
- D. Microprocessor-based, fuel/air mixing controls.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.
- C. Install boiler on existing concrete housekeeping base.
- D. Coordinate factory installed controls with Section 23 0913.
- E. Pipe cooled condensate produced by the combustion process from the boiler condensate connection and/or flue stack with suitable piping material to neutralizer prior to discharging into nearest floor drain.
- F. Install primary boiler pump in accordance with Section 23 2123.
- G. Provide piping connection and accessories in accordance with Section 23 2114.
- H. Vent combustion fumes in accordance with manufacturer's recommendations. Refer to Section 23 5100.

3.02 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. Demonstrate proper operation of equipment to Owner's designated representative.
- C. Demonstration: Demonstrate operation of system to Owner's personnel.
 1. Use operation and maintenance data as reference during demonstration.
 2. Briefly describe function, operation, and maintenance of each component.
- D. Training: Train Owner's personnel on operation and maintenance of system.
 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 2. Provide minimum of two hours of training.
 3. Instructor: Manufacturer's training personnel.
 4. Location: At project site.

END OF SECTION