

# DELTA COLLEGE DOMESTIC WATER HEATER SYSTEM REPLACEMENT

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SECTION 22 05 00

PLUMBING REQUIREMENTS

PART 1 GENERAL

1.1 RELATED SPECIFICATIONS AND DOCUMENTS

- A. Drawings and related specifications for this project including General and Supplementary Conditions, Division 1, General Requirements, Instructions to Bidders, Addenda's, etc. apply to and are considered a part of Division 22 - Mechanical Work.
- B. Information in this division is intended to clarify or make additions to the requirements set forth in the General Conditions, Supplementary Conditions, and Division I of these specifications. Any conflict between this Division 22 and other sections or divisions of the specifications or drawings shall be brought to the attention of the Architect/Engineer in writing as a request for addendum prior to the bid opening.
- C. Furnish all equipment, materials, articles, items, operations or methods listed, mentioned or scheduled on drawings, these specifications, manufacturer's installation instructions and include all labor, materials, equipment and incidentals necessary for their complete installation and operation.
- D. All information contained in this section applies to all sections within Division 22 as if it was part of each section.

1.2 DRAWINGS AND SPECIFICATIONS

- A. The drawings and these specifications are intended to supplement each other and any material or labor called for in one shall be furnished even if not specifically mentioned in both. Any material or labor which is neither shown on the drawings nor listed in this specification, but is normally incurred or required for completion of work shall be furnished. If there is a discrepancy between the drawings and specifications, the more stringent of the two shall be followed.
- B. Drawings are diagrammatic and are intended to show approximate location and general arrangement of systems and equipment. No attempt has been made to show every ell, tee, etc. Drawings shall not be scaled for location of systems, equipment, etc. All dimensions whether given on drawings or scaled shall be verified in field and coordinated with all other trades and existing field conditions. Some plumbing, piping, equipment, etc. locations may require changes in location due to field conditions and coordination with other trades will be made with no additional cost to the Owner. Failure to check will be no reason for additional compensation.
- C. These drawings and the associated specifications are intended to provide complete furnishing, installation and operational plumbing systems as specified under Division 22 and as called for on the drawings. If these drawings and associated specifications have information omitted that would not allow a completely operational system as is the intent of the Engineer, the bidder shall notify the Engineer a minimum one week prior to the bid date to allow for addenda. Once

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bids have been received, the Contractor shall be responsible for material, labor, etc., to furnish and install a completely operational plumbing system as is the intent of these drawings and associated specification.

- D. The installation of all systems, equipment, etc., is subject to clarification with submitted shop drawings and field coordination requirements. Equipment outlines shown on drawings or dimensioned on drawings are limiting dimensions. Any equipment that reduces the indicated clearances or exceeds specified or scheduled equipment dimensions shall not be used.
- E. The Architect/Engineer and Owner reserve the right to make minor changes in the location of equipment, piping, ductwork, etc. at the time of rough-in without additional cost to the Owner.
- F. The Mechanical Trades Contractor shall have completed for his portion of work, at least one installation of size and type comparable to this project and has been in satisfactory operation for at least two complete years. The Mechanical Trades Contractor shall also have a developed service department capable of negotiating service contracts with the Owner for systems herein specified.

#### 1.3 AUTOCAD BACKGROUND FILES

- A. The Contractor shall include in their bid any cost for requesting AutoCAD backgrounds for their use from the Architect or Engineer. The cost will be \$150.00 for the first plan, and \$50.00 for each additional plan that may be requested for AutoCAD use. A waiver of responsibility for the Architect and Engineer related to Contractor use of the CAD files shall be signed by the Contractor.

#### 1.4 MANUFACTURER'S SPECIFICATIONS AND CAPACITIES

- A. Some equipment, plumbing fixtures, materials, etc. that are scheduled on the drawings or listed in any addenda may not be specified in this specification. The manufacturer's specification and capacities shall be considered included and part of this specification whether it is specified in this specification or noted or scheduled on the drawings. The contractor shall remove and replace any "substituted" equipment or material, which has been installed or is on site, which in the opinion of the Architect/Engineer does not meet the scheduled equipment or materials, manufacturer's capacities or specification at no additional cost to the Owner.

#### 1.5 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

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- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in pipe shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. PE: Polyethylene plastic.
  - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### 1.6 LOCAL CONDITIONS

- A. Before submitting proposals, each contractor shall examine these specifications and associated drawings, addenda, etc. and shall examine the site of the project. The bidder shall fully investigate the site of this project, investigate coordination of his work with all other trades and existing conditions and completely satisfy himself as to the conditions to which the work is to be performed before submitting his/her bid. No allowances or considerations will be given at a later date for alleged misunderstanding as to the requirements of the work, materials to be furnished, or conditions required by the nature of this project site and coordination by the neglect on the bidder's part to make such an examination and coordination.
- B. Drawings show approximate location of existing services. The mechanical and electrical trades shall check with local utility companies or municipal agencies for exact location of services which they expect to encounter. The Mechanical Trades Contractor shall be responsible for hiring a company such as "Miss Dig" to stake out and locate all utilities in areas of excavation before commencing any work. The Mechanical Trades Contractor shall verify all elevations and locations of existing underground lines which are to be connected into or routed over or under. This verification shall be done prior to beginning work at this project.

#### 1.7 QUALITY ASSURANCE

- A. All work shall be performed in accordance with all local and state codes, laws and regulations applicable to the work for this project. The contractor shall be responsible for all permits and costs for inspections, etc., and for checking with each utility company supplying service to this project and shall determine from them all, any changes in boxes, meters, valves, service, etc., and shall include all cost for inspections, revisions to services, etc. in his bid as required by local agencies, utilities, etc. No extra payment will be made for such items after the contractor submits his bid.

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- B. In addition to all applicable Federal, State and local codes, the standards and codes listed below shall apply to all mechanical work. The reference to codes and standards shall be referenced to the latest edition or revision.
1. American Gas Association (AGA)
  2. American National Standard Institute (ANSI)
  3. American Society of Mechanical Engineers (ASME)
  4. American Society for Testing materials (ASTM)
  5. American Water Works Association (AWWA)
  6. American Welding Society
  7. ANSI code of Pressure Piping and Unified Pressure Vessels
  8. Cast Iron Soil Pipe Institute
  9. National Electrical Manufacturer's Association (NEMA)
  10. Standards of the Hydraulic Institute
  11. Underwriters' Laboratories (UL)
  12. Williams-Steiger Occupational Safety & Health Act (OSHA)
- C. In the event of conflict between drawings, codes, standards or specifications, the most stringent requirement shall apply.

1.8 SUBMITTALS AND SHOP DRAWINGS

- A. Submit electronic sets of complete shop drawings for all plumbing equipment and materials associated with Division 22 and associated drawings to the Architect/Engineer for review before fabrication of work or ordering of equipment. Shop drawings shall be submitted at the earliest possible time.
- B. Shop drawings shall be first reviewed by the contractor. Inaccurate shop drawings shall be corrected by the contractor to meet specifications and schedules for this project. The contractor shall then initial the shop drawings as having been reviewed before submitting to the Architect/Engineer. Shop drawings shall have, in addition to the mechanical information, the electrical requirements for minimum circuit amperes and maximum fuse size ratings of the equipment.
- C. Drawings which are rejected must be corrected and returned for Architect/Engineer review before ordering.
- D. Furnish to the job site copies or prints of shop drawings that have been reviewed by the Engineer as soon as possible.
- E. Include a copy of each shop drawing in the Operation and Maintenance Manual.
- F. The checking and reviewing of shop drawings by the Architect/Engineer shall be construed as assisting the contractor and the Architect/Engineer's action does not relieve the contractor from the responsibility for errors or omissions which may exist thereon. The contractor shall be held responsible for errors or omissions that are discovered after approval process and must be made good by the contractor.

1.9 PERMITS, INSPECTIONS AND TESTS

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- A. The Mechanical Trades Contractor shall take out all permits and arrange for necessary inspections and shall pay all assessments, fees and costs, etc., and make all tests as required by applicable codes. At the completion of the project, the Mechanical Trades Contractor shall furnish certificates of inspection and approval and secure final occupancy permit. Record copies shall be included in the Operation and Maintenance manuals.

#### 1.10 RECORD DRAWINGS

- A. Maintain an up-to-date set of "record" drawings showing actual equipment, plumbing piping, etc. installation locations. Exact dimensions from column lines for all concealed work and tie-ins with elevations noted shall be included.
- B. Include a set of reproducible drawings and a set of prints in each Operation and Maintenance Manual.
- C. The Engineer reserves the right to request and be furnished any additional information he deems necessary to be shown on the record drawings.

#### 1.11 OWNER'S INSTRUCTIONS

- A. Upon completion of the project, the contractor shall be responsible for instructing the Owner's operating staff, in the presence of the Architect/Engineer's representative, in the proper operation and maintenance of the mechanical systems and equipment. Include a statement signed by the Owner that instructions have been given for proper operation and maintenance of the mechanical systems and equipment.

#### 1.12 GUARANTEES

- A. Furnish a written guarantee, to the Architect/Engineer, that will make the contractor responsible at his own expense for any imperfections in material and/or workmanship which may develop under ordinary use within a period of one (1) year from final Owner's acceptance of the work.
- B. Furnish all written guarantees from equipment and/or material manufacturers which shall include the operating and performance conditions and capabilities upon which they are based.

#### 1.13 PORTABLE AND DETACHABLE PARTS

- A. Retain all portable and detachable parts of installation such as keys, spare accessories, operating manuals, etc. include in the Operation and Maintenance Manual.

#### 1.14 OPERATION AND MAINTENANCE MANUALS

- A. Furnish to the Architect/Engineer two (2) copies of an approved bound (3 ring binder) book with tabs for sections covering each item of equipment. These notebooks shall include shop drawings, maintenance manuals, operating manuals and parts lists to instruct the Owner on proper operation and use as well as maintenance for each piece of equipment. These books shall also include

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contractors', subcontractors' and manufacturers' names, telephone numbers and addresses.

- B. The manuals must be approved by the Architect/Engineer before final payment to the contractor. The Engineer reserves the right to request and be furnished any additional information that he deems necessary to be included in the manuals.

1.15 RESPONSIBILITIES FOR USE OF SUBSTITUTE MATERIALS

- A. Contractor shall notify Architect/Engineer in writing at least ten (10) calendar days before bids are due for approval to use materials and/or equipment other than that which has been specified or scheduled. If substitute materials and/or equipment are approved and used, it will be this contractor's responsibility to guarantee that the items will function as the specified equipment or materials, will in no way alter the design of the structure or system, and will not require any additional mechanical work such as piping, plumbing, etc. Any additional cost required by substitute materials will be the responsibility of the contractor.
- B. It will be the contractor's responsibility, at his own expense, to remove or replace any non-approved equipment or material or any approved equipment or materials not originally specified or scheduled if equipment and materials do not meet with the satisfaction of the Architect/Engineer.
- C. It shall be the Contractor's (Mechanical Trades) responsibility to coordinate and pay for any Electrical Contractor costs due to any changes in substitute materials and/or equipment's power requirements, which differ from that shown on the design documents.
- D. No consideration will be given to requests for substitute materials because of delivery problems unless the contractor can prove that orders were placed as soon as possible after contract was awarded and that delays were not caused by submittal of unscheduled or unspecified (substituted) materials to the Architect/Engineer.

1.16 COST BREAKDOWN AND EQUIPMENT LIST

- A. The successful bidder shall be responsible for submitting a cost breakdown to the Architect/Engineer and Owner within ten (10) calendar days after date of request of the breakdown. During progress of the work, if changes occur which cause additional cost, the price on such items shall be broken down in accordance with the items listed in the breakdown.
- B. The bidders shall be responsible for submitting a complete list of all equipment manufacturers, makes, models, etc. that will be used for this project with their proposal. The equipment list shall be typed on the contractor's letterhead and shall be signed by the authorized officer.

1.17 MATERIALS AND EQUIPMENT

- A. Materials and equipment furnished under this project shall have a minimum warrantee of one (1) year. All materials and equipment shall be new, of first class quality and shall be furnished, delivered, erected, installed and finished in every

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detail and shall be so selected and arranged as to fit into the building space. All material or equipment that is not specified but necessary for this project shall be subject to the approval of the Architect/Engineer.

- B. Any materials or equipment not specified or scheduled but similar to that which has had prior approval shall be listed as a substitution and noted on the proposal form as such.
- C. The contractor shall include all miscellaneous materials and labor required to completely install and operate the plumbing systems as is intended by these drawings and specification.

#### 1.18 SCHEDULE, COORDINATION AND INSTALLATION OF WORK

- A. The contractor shall carry on work in such a manner as to meet the dates as scheduled by the General Contractor and shall work overtime at no expense to the Owner as required to comply with the schedule. This contractor shall schedule all work with Owner and Architect/Engineer and schedule shut down of systems with Owner.
- B. Examine the site and all drawings and specifications and coordinate work with all other trades before commencing work for this project. Arrange work essentially as shown with the exact layout to be made on the job to suit actual conditions. Precise locations of equipment and materials shall be coordinated and shall be the responsibility of this contractor. Should any conflicts in location occur, and necessary deviations from drawings are required as determined by the Architect/Engineer, the contractor shall make necessary adjustments without additional cost to the Owner.
- C. All equipment, plumbing piping, etc. shall be located and/or routed to allow for the most convenient access for servicing.
- D. Arrange for necessary access doors, panels, etc. to allow servicing of equipment, piping, valves, etc. Perform any cutting and patching as required, made necessary by failure to make proper arrangements.
- E. Indicated equipment connections, sizes and locations shall be verified and connected according to manufacturer's shop drawings and installation instructions. Thoroughly investigate the space provided for equipment and connections before ordering equipment. All equipment shall be selected to fit into the space allowed, including connections with adequate space allowed for operation and maintenance.
- F. All work shall be installed in a neat and workmanlike manner, using skilled personnel thoroughly qualified in the trade or duties that they are to perform. Rough work will be rejected.
- G. Coordinate all equipment deliveries and schedules to allow timely installation. Contractor shall separate equipment into sections and reassemble in building if required by the installation at no extra cost to the Owner.



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- H. Furnish a superintendent approved by the Architect/Engineer to oversee and coordinate the work to be performed with all other trades.
- I. Coordinate location of pipes, plumbing, etc. with other building components such as structural components (beams, joists, columns, etc.), electrical components (lighting, conduits, etc.) and architectural components (walls, ceilings, floors, pipe chases, roof, etc.).
- J. Before starting work, Contractor shall verify that available space for proposed pipes, equipment etc. is adequate for the intended purpose and will result in a first class installation. Regardless of drawings, responsibility for first class operating systems rests with the Contractor.
- K. Arrange for chases, slots, openings, etc. and other building components to allow for plumbing systems installation. Coordinate cutting and patching of these components to accommodate installation. This contractor shall be responsible for accurately locating for the general trades all chases, shafts, etc. and shall be responsible for all cutting and patching if these chases were not accurate or not coordinated in time with the general trades. Coordinate installation of all sleeves in walls, floors or other structural or architectural components.
- L. Sequence, coordinate and integrate installation of equipment and materials for efficient work flow during the project. Particular attention should be spent on larger pieces of equipment.
- M. Install equipment and materials with provisions for necessary access for service and maintenance. Allow space for removal of all parts that may require replacement or servicing.
- N. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- O. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. When access panels are required, valves and equipment components requiring access shall be located to minimize the number of panels.
- P. Examine the work as it progresses and alert the Architect/Engineer in writing of any instances or obstructions that will prevent this contractor from performing his/her work.
- Q. The Mechanical Trade shall be responsible for all coordination of all site utilities, the gas company, etc. including coordination of all new and existing natural gas loads.

#### 1.19 DELIVERY, STORAGE, AND HANDLING

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

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- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- C. Furnish and maintain a weatherproof storage facility on the site of adequate size to store miscellaneous equipment and/or materials to prevent exposure to the weather. Location of shed shall be determined by the Owner and Architect/Engineer. The Owner reserves the right to deny storage of materials or equipment in any existing or new buildings.

#### 1.20 COOPERATION WITH ARCHITECT/ENGINEER AND OTHERS

- A. Coordinate all aspects of the plumbing system installation with all other trades, existing conditions, etc.
- B. If the bidder believes that changes in design are required to meet intended design capacities and operation or material and/or equipment is obviously omitted from these specifications and drawings, the bidder shall contact the Architect/Engineer in writing at least ten (10) days before bid date. The acceptance of a bid by the Owner shall be binding and shall indicate that the bidder does not require any changes in design nor additional costs in order to meet the design and performance of the mechanical system as indicated in these specifications and drawings.

#### 1.21 WORK INVOLVING OTHER TRADES

- A. Equipment or materials specified in Division 22 may have to be installed by other trades (such as electrical trades or architectural trades) due to code requirements or union jurisdictional requirements. Where this occurs, this contractor shall include all costs required by other trades to complete the work and hire the respective trade to perform this work.

#### 1.22 PERFORMANCE DATA AND ACCESSIBILITY

- A. All performance data specified in this specification or scheduled on drawings shall be considered actual performance of the equipment after installation. The supplier and installer shall be responsible for suitable allowances to adjust equipment to design capacities when actual operating and installation conditions differ from drawings.
- B. All equipment and materials shall be installed to allow access for servicing and maintenance. Coordinate final location of such equipment and materials that are concealed with required access doors on panels. Allow ample space for replacement or servicing.

#### 1.23 CUTTING AND PATCHING

- A. Unless noted otherwise, the Mechanical Trades shall be responsible for all cutting, patching and associated work required under Division 22. This work shall be performed by trades normally performing this type of work except drilling of holes shall be done by the contractor requiring same. This includes replacing areas of cutting required by this work with proper reinforcing, termite shielding, materials,

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finishing, etc. to restore the areas to their original condition, and filling all openings around ducts, piping, etc. with approved fire retardant materials. Regardless, all drilling of holes shall be the responsibility of the Contractor requiring same.

- B. If noted on drawings that the General Trades will be responsible for all cutting and patching, it will be the Mechanical Trades responsibility to notify all General Trades during bidding of all areas requiring cutting and patching. Regardless, all drilling of holes shall be the responsibility of the contractor requiring same.

#### 1.24 WORK IN EXISTING BUILDINGS

- A. Coordinate and schedule all work in existing building with Owner and Architect/Engineer. Systems shall be kept in operation at all times if at all possible. If a system shut-down is required, the contractor shall schedule with the Owner, the time and length of shut-down. A system shall not be shut down without written permission from the Owner.
- B. All existing equipment, plumbing, piping, etc. that is to be removed shall remain the property of the Owner. The contractor shall remove and locate this material that remains the property of the Owner to a location determined by the Owner somewhere on site. If the Owner does not want to maintain possession of the removed material, the contractor shall be responsible for removing material from the site and disposing of this material as necessary to meet all codes and requirements and shall pay all costs as required for any disposal fees, inspections, permits, etc.
- C. All existing piping, equipment, etc. whether shown on drawings or not that is to be removed and/or abandoned and does not remain property of the Owner shall be removed from site.
- D. Any existing plumbing, piping, valves, mechanical equipment, etc. serving the existing building which are shown or not shown on drawings and are required for systems operation shall remain in use. If these systems require relocation to allow installation of new systems, the contractor shall be responsible for relocating to an Owner and Architect/Engineer approved location. The contractor shall pay all cost for this work and include such cost in his/her bid. (As specified previously, contractor shall be responsible for examining site and include all cost for work required to complete this project.)
- E. When active services, etc. are encountered in this project, the contractor shall furnish and install bracing, support, etc. as required to protect and keep these services active. (As specified previously, these drawings are diagrammatical. The contractor shall be responsible for verification of all existing services, piping, equipment, etc.).

#### 1.25 ACCESS TO EQUIPMENT, VALVES, ETC.

- A. Coordinate access panels with type of construction and furnish access panels in areas that are non-accessible. Access panels shall be furnished by this contractor and installed by the General Contractor. The access panels shall be all approved,

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UL labeled and fired rated and shall be located and sized to allow access to equipment, valves, etc.

- B. Where access panels are required, valves, equipment etc. shall be located as to require the least number of access panels.

#### 1.26 EQUIPMENT CONNECTIONS

- A. Connections to equipment, plumbing fixtures, etc. shall be made in accordance with shop drawings, rough-in dimensions furnished by the manufacturer, codes, etc. and may vary with connections shown on drawings. The contractor shall be responsible for making connections and number of connectors as per shop drawings, codes, etc. at no additional cost to the Owner.

#### 1.27 ELECTRICAL CONNECTIONS

- A. The Electrical Trades shall be responsible for furnishing and installing all electrical equipment, wiring, etc. required for operation of mechanical equipment unless otherwise noted on the drawings. The Mechanical Trades shall furnish detailed information and wiring diagrams to the Electrical Trades for all equipment specified and/or scheduled for this project. In the event that the Mechanical Trades furnishes an "approved equal" or "alternate" that require changes in the original electrical design, the Mechanical Trades shall pay all costs to the Electrical Trades as required to make satisfactory adjustments. All electrical work shall be done in accordance with the latest edition of the National Electric Code.

#### 1.28 MOTORS, MOTOR STARTERS AND DISCONNECTS

- A. Unless otherwise noted on drawings, motors shall be of constant speed 1750 rpm, new NEMA Design B, 40°C rise, horse power rated, open drip-proof except TEFC in dirty atmosphere, induction type motor with service factor of 1.15 and be of sufficient capacity to continuously operate the apparatus to which it is connected under all conditions of operation without exceeding nameplate ratings.
- B. Motors shall be premium efficiency as calculated using IEEE test method 112B.
- C. Motors ½ Hp. or larger shall be three phase; motors under ½ Hp. shall be 115 volt, 60 cycle, single phase. Before ordering the motors, the contractor shall verify correct motor voltage with the Electrical Trades and field conditions.
- D. The Mechanical Trades shall furnish, for equipment under Division 22, all special switches, disconnects, starters, alternators, etc. as specified or scheduled to be factory furnished and/or factory installed with the equipment including wiring diagrams, etc. whether it is to be factory installed or field wired. All other motor starters, disconnects, etc. not noted as factory furnished shall be furnished and installed by the Electrical Trades.
- E. Starters that are to be factory furnished with equipment shall be of the combination type and shall be as specified under Electrical Trades Division. Furnish overload protection for each phase.

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F. All wiring methods and materials shall meet NEMA, National Electric Code and State of Michigan Code requirements.

G. All displays on control panels shall be on face of the panels.

1.29 EXCAVATION AND BACKFILLING

A. Furnish all excavation, backfilling and removal of excess dirt to accomplish installation of Division 22 mechanical work unless otherwise noted on drawings.

B. All excavation shall be by open cut from the surface. Contractor shall determine whether excavation shall be by machine or by hand except where existing utilities may be located where excavation shall be by hand. Contractor shall be responsible for all damage to existing facilities and services. Excavation shall be to a depth of at least 6" to allow granular bedding below pipe or duct.

C. If for any reason the work is suspended, the contractor shall properly protect the excavation and leave the areas unobstructed.

D. Trench width shall allow sufficient width at centerline of pipe to allow at all times a first class construction/installation method but in no case should be less than 12" larger than the nominal pipe or duct size. This shall especially be true in areas that joints must be connected. Joint holes may have to be made with overhanging sides to make installation safe for workmen.

E. The excavation shall be at all times finished and backfilled to the required grade after completion and approval of work. Not more than 100 feet of trench shall be excavated and open unless written approval is given by the Architect/Engineer.

F. The subgrade shall be 4" to 6" below the pipe of granular bedding graded and tamped by hand or mechanical means to the exact elevation required at the bottom of the pipe. Granular materials shall be approved fine aggregate meeting MDOT #2NS specifications. This material shall pass a 1/2" sieve but will be retained on a #4 sieve. If poor soil conditions exist which will not give proper support to the pipe, duct or structure, furnish granular fill as required to remedy this situation and give proper support.

G. Furnish and install properly sloped sheet piled, shored and braced in areas that the soil requires this to maintain a proper excavation and prevent any movement of earth which could in any way damage the work under construction. When removing the sheeting and bracing, special care should be taken to prevent any caving of the sides of the excavation and injury to the completed work or adjacent property.

H. Take all necessary action to keep trenches and other excavation areas free from water at all times. Use such methods as pumping, ditching, well pointing, etc. to prevent water in trench or excavation. Dewatering of trench shall have constant supervision.

I. Backfill excavation and trenches with approved granular material around sides of pipe and at least 12 inches above the top of the pipe laid not more than in 6 inch layers that are thoroughly tamped to 95% of its maximum density. There shall be no backfilling by any mechanical means until the granular material has been firmly

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tamped around the entire pipe to 12 inches above the pipe. All material used for backfilling shall be approved by the Architect/Engineer. Wherever trenching crosses walks or roadways or isolated inside of building, backfill top 6'-0" of trench with sand or bank run gravel in layers not to exceed 6 inches in depth and carefully compact by hand or machine. Do not backfill with frozen materials.

- J. No piping shall be covered until it has been tested, inspected and approved. Upon completion of backfilling, grade shall be restored in indicated elevation and left in reasonable condition for finish grade by others unless otherwise noted on drawings.
- K. Before final acceptance of work, all disturbed streets, drives, curbs, walks, parking areas, etc. shall be paved, graveled or other to as near their original condition as possible. All unused excavated material shall be removed from site if directed by the Architect/Engineer.

#### 1.30 BASES AND SUPPORTS

- A. This contractor shall be responsible for furnishing all equipment pads and supports for equipment and materials required by Division 22 unless otherwise noted on drawings.
- B. All floor mounted mechanical equipment shall have a reinforced concrete pad furnished unless otherwise noted on drawings. The concrete pads shall be tied to the building floor with expansion bolts located maximum of 4'-0" on centers with a minimum of four (4) bolts, set before pouring and concealed within the pad. The Mechanical Trades shall verify exact pad or support size with the equipment manufacturer and shall size pad with adequate area to allow sufficient room for equipment mounting hardware, etc. Concrete pads shall have a 45 degree bevel at the top edge. The contractor shall verify exact location of concrete pads.
- C. Furnish all steel, hanging material, rods, etc. for suspending equipment off floor unless otherwise noted on drawings for equipment to be furnished under Division 22. This includes all structural steel for supporting between beams.
- D. All support structure shall be of strength to safely withstand all stresses and loads to which they will be subjected and shall distribute load properly over the building area. Supports shall be designed to avoid undue strain to equipment and to avoid interference with piping, pipe connections, service and maintenance clearances, etc.
- E. Where equipment is to be floor mounted and requires legs, this contractor shall furnish and install structural steel members or steel pipe and fittings for legs. Fasten and brace to equipment and furnish flange at base to allow bolting to floor.
- F. Where equipment is to be ceiling or wall mounted, furnish necessary platform, structural steel, hardware, etc. as is most suitable for support of this equipment.
- G. All supports shall be approved by the Architect/Engineer.
- H. All piping, plumbing, etc. shall be suspended from structural steel members utilizing rods and approved hanger devices. Do not use metal deck for support. Beam clamps such

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as the Grinnell Fig. 260 or approved equal shall be used. Sheet metal "straps" shall not be used in place of rods.

- I. The mechanical trades shall be responsible for furnishing and setting in place all mechanical equipment, roof curbs and plumbing, piping roof curbs. The general trade shall be responsible for the roof work and associated flashing. The mechanical trade shall furnish and install treated wood base blocking as required to level curb and to match roof insulation thickness. Curb shall be as specified, or if not specified should be similar to Pate or Thy-curb with heavy gauge galvanized steel, insulated and with wood nailer. Height of curb scheduled or specified shall be height required to top of curb above finished roof. If height is not specified or noted, a minimum 12" high above finished roof will be required. (pipe support units shall be at height required).

#### 1.30 SLEEVES, PLATES AND COLLARS

- A. Furnish all sleeves, plates and collars for plumbing piping, etc. passing through walls, floor ceilings, foundations, etc. Coordinate with the General Contractor the exact location and size of required openings. No pipe shall pass through a wall, floor ceiling, etc. without a sleeve. This contractor shall be responsible for sleeve locations and securing sleeves before concrete is formed.
- B. Sleeves for steel pipe shall be standard weight black steel pipe. For walls, foundations and ceilings, sleeve shall be kept flush with finished surfaces. For floors, the sleeve shall be set flush with bottom of concrete construction and be extended up ¼" above concrete floor. Sleeves shall be set in place before construction of walls, floors, ceilings, etc.
- C. Sleeves for copper pipe shall be type "M" hard copper tubing installed typical to that of steel pipe sleeves.
- D. Sleeves for piping shall be sized to allow insulation to run continuous through sleeve whenever possible and to allow not less than ¼" all around bare pipe or insulation.
- E. Where insulated piping passes through walls or floor sleeves, furnish 22 gauge galvanized band around insulation of same length as the sleeve length. Band shall fit snugly over insulation and be held in place by steel metal collars all around insulation to cover openings.
- F. All penetration voids shall be sealed smoke tight with non-combustible materials similar to 3M or Hilti firestop systems to maintain the integrity of the fire rated structure. In a non-rated assembly, seal all voids with non-hardening sealant.
- G. Where bare piping 2" and smaller pass through wall or floors, furnish polished chrome plated brass escutcheons, split type. Bare piping 2½" and larger that pass through walls or floor, furnish 22 gauge galvanized steel metal collars so as to cover opening.
- H. Where piping penetrates an outside wall, below grade, utilize a mechanical sleeve, similar to Link-Seal, with stainless steel nuts and bolts on fasteners.

DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT  
Plumbing Requirements

1.31 RIGGING AND HOISTING

- A. Perform all required rigging, hoisting, transportation, moving, etc. of all equipment, materials, etc. to be furnished and/or installed under Division 22 whether furnished by this contractor or by the Owner or other trades.

1.32 STORAGE FACILITY

- A. Furnish and maintain a weatherproof storage facility on the site of adequate size to store miscellaneous equipment and/or materials to prevent exposure to the weather. Location of shed shall be determined by the Owner and Architect/Engineer. The Owner reserves the right to deny storage of materials or equipment in any existing or new buildings.

1.33 PROTECTION FROM DAMAGE

- A. The contractor shall be responsible for all materials, equipment, etc. and all work installed by himself and shall protect it from damage until final acceptance of this project by the Owner.
- B. Furnish all coverings and protection from dirt, dust, rain, storm, heat, traffic, wear, etc. and all possible injury including that by other workmen. Any equipment, workmanship, materials, etc. damaged prior to final acceptance by the Owner of this project shall be properly repaired at no expense to the Owner.
- C. Protect all plumbing fixtures and other equipment from damage by covering or coating. Any dented, scratched, rusted or marred surface finishes will not be accepted.
- D. Protect all equipment, materials, etc. from freezing.

1.34 COMMON PIPE MATERIALS AND INSTALLATION INSTRUCTIONS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. Refer to individual Division 22 piping Sections for special joining materials not listed below.
  - 1. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
    - a. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
      - 1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      - 2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
    - b. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.



## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

### Plumbing Requirements

2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
3. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
4. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
5. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
6. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
7. Solvent Cements for Joining Plastic Piping:
  - a. ABS Piping: ASTM D 2235.
  - b. CPVC Piping: ASTM F 493.
  - c. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - d. PVC to ABS Piping Transition: ASTM D 3138.
8. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

#### 1.35 PIPE HANGERS AND SUPPORTS

- A. Hangers and saddles shall be Modern Pipe Support Corp., Grinnel/Anvil, Autogrip, or M-CO. Inserts shall be of the type to receive a machine bolt head or nut after installation, permit horizontal adjustment, and shall be flush with the surface. For copper pipe with steel hangers, clean and wrap pipe with two layers of plastic insulating tape at point of contact. Roller supports shall be adjustable type with insulated standoff. Rods shall be used for suspended installation. Sheet metal "straps" shall not be used in place of rods.
- B. Hangers for piping with vapor barrier sealed insulation shall be multipurpose pipe saddles fitting over the insulation. Wire or perforated strap iron will not be permitted for pipe supports. Do not support hangers from roof deck. Furnish and install all support steel as required to suspend from structural steel joist or beams. Hangers shall be clevis or split ring type with vertical adjustment and beam clamp similar to Grinnell/Anvil Fig. 260, with maximum spacing per ASHRAE Standards:

Pipe Size	Steel Pipe	Copper Pipe	PVC Pipe	Rod Size
½ to ¾ inch	6 feet	5 feet	4 feet	3/8"
1 inch	7 feet	5 feet	4 feet	3/8"
1 ¼ inch	7 feet	7 feet	4 feet	3/8"
1½ inch	7 feet	7 feet	4 feet	1/2"
2 inch	10 feet	8 feet	4 feet	1/2"
2½ inch	11 feet	9 feet	4 feet	5/8"
3 inch	11 feet	9 feet	4 feet	5/8"
3 ½ inch	13 feet	11 feet	4 feet	5/8"
4 inch	14 feet	12 feet	4 feet	3/4"
5 inch	14 feet	12 feet	4 feet	3/4"
6 inch	14 feet	--	4 feet	3/4"
8 inch	16 feet	--	4 feet	7/8"

DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT  
Plumbing Requirements

10 inch	16 feet	--	4 feet	7/8"
12 inch	20 feet	--	4 feet	1"

- C. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
- D. Hangers for Pipe Sizes ½ to 1½ Inch: Malleable iron, adjustable swivel, split ring.
- E. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
- F. Hangers for Hot Pipe Sizes thru 4 Inches: Carbon steel, adjustable, clevis.
- G. Hangers for Hot Pipe Sizes 5 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
- H. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- I. Wall Support for Pipe Sizes up thru 3 Inches: Cast iron hook.
- J. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
- K. Vertical Support: Steel riser unistrut clamps at high, mid, and low locations.
- L. Floor Support for Cold Pipe all sizes and Hot Pipe Sizes up thru 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- M. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- N. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- O. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustments, top slot for reinforcing rods, lugs for attaching to forms, size inserts to suit threaded hanger rods.

1.36 PLUMBING, PIPING, AND EQUIPMENT SUPPORT

- A. Attachments of mechanical equipment to structural members are the responsibility of the installing trade. Structural members shall not be field cut, welded or otherwise modified without approval of the Architect/Engineer. Attachment to steel joist shall be made at panel points. When routing piping or ductwork perpendicular to joist, a support shall be provided at every steel joist; when parallel to joist, a support shall be provided at no more than 6' on centers or two panel bays. Structural members shall not be overloaded as a result of attachments. Attachment/equipment loading for all trades resulting in total load greater than an equivalent uniform 5 psf for any member shall be submitted to the Architect/Engineer for review. Mechanical Trades may contact the project Structural Engineer as required for panel point location assistance and welder certification requirements. Electrical Trades are still responsible for design, layout,

## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

### Plumbing Requirements

and fabrication and installation of electrical supports and support attachment methods. Mechanical Trades shall submit attachment methods to the Structural Engineer for review.

- B. Install products in accordance with manufacturer's instructions.
- C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- D. Do not use spring steel clips and clamps.
- E. Do not use powder-actuated anchors.
- F. Do not drill or cut structural members without permission from Architect/Engineer.
- G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

#### 1.37 PIPING SYSTEMS SHUT OFF VALVES

- A. Shut off valves shall be installed at all branch lines off main piping, or where mains divide/separate to serve different areas, to allow isolation of all branch piping and systems they serve such as toilet rooms, areas or wings of the building, etc.

#### 1.38 CLEANING AND FINISHING

- A. During construction period, remove all debris, rubbish, tools, equipment, unused materials, etc. as required or requested by the Architect/Engineer. All cost for cleanup and removal will be the responsibility of the contractor.
- B. Upon completion of the project and before final acceptance by the Owner, the entire installation shall be thoroughly cleaned, all rubbish and unused material removed to the satisfaction of the Architect/Engineer. All dust and dirt shall be removed from all equipment, piping, ductwork, etc.
- C. Thoroughly clean all floor drains, cleanouts, and plumbing fixtures. Clean all trays and strainers.
- D. Finish paint all equipment, materials, piping, etc. as noted on drawings or listed in this specification. Match Owner's existing color scheme. Any Division 22 equipment which has been scratched or damaged shall be finished equal to the original finish.

#### 1.39 EQUIPMENT/SYSTEMS START-UP

- A. Furnish and schedule manufacturer's start-up service for all equipment and systems. These start-up services shall be performed in the presence of, and to the satisfaction of the Owner and Architect/Engineer.

#### 1.40 EQUIPMENT/SYSTEMS SIGN-OFF

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- A. The Mechanical Trades shall furnish written sign-offs on all systems stating that the equipment and systems have been checked, tested, started and that their operation has been verified correct through the entire range of operation that can be expected through the seasons.

1.41 SUBSTANTIAL COMPLETION

- A. Contractor shall submit a letter to the Architect/Engineer advising that all work has been completed in accordance with plans and specifications and the project is ready for a final walk-thru.

END OF SECTION

SECTION 22 05 10

PLUMBING SYSTEMS TESTING, CLEANING, WATER TREATMENT & STARTUP

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Testing of piping systems.
- B. Cleaning of piping systems.
- C. Chemical treatment.
- D. Substantial completion check list and sign-off forms.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself, but is supplementary to the entire specification and drawings.

1.3 SCOPE OF WORK

- A. The work covered by this specification consists of furnishing all labor, equipment, material, chemicals or methods that are mentioned, listed or scheduled on drawings or are in this specification. This includes all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the cleaning, flushing, testing and chemical treatment of the piping systems for this project. The work covered under this section of the specification is in no way complete within itself, but is supplementary to the entire specification and drawings.
- B. The substantial completion forms shall be required to be signed and submitted to the Architect/Engineer for approval prior to any insulation of piping systems or installation of ceiling tiles. The person that signs the substantial completion forms shall witness the testing, flushing and chemical treatment of the systems. The signature person's company shall be responsible for all cost incurred with future work by the Architect/Engineer or Owner due to inadequate testing, cleaning, operation or chemical treatment of the piping systems.

1.4 SUBMITTALS

- A. Submit electronic copies of the completed and signed substantial completion forms included in this section. Submit to the Architect/Engineer as system flushing, testing, and chemical treatment occurs. The Mechanical Trade shall maintain one set of substantial completion forms and submit them to the Architect/Engineer prior to the Architect/Engineer final project walk-through.

DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT  
Plumbing Systems Testing, Cleaning, Water Treatment & Startup

- B. Submit electronic copies of all equipment, chemicals and product data being furnished to this project for approval.
- C. Submit electronic copies of manufacturer's installation instructions, including placement of equipment in systems, piping configuration, and connection requirements.
- D. Submit certificate of compliance from authority having jurisdiction, indicating approval of systems that require review by local and state authorities.

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual installation locations of piping and equipment including sampling points and location of chemical injectors.

1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for public sewage systems.
- B. Products requiring electrical connection and listed and classified by UL as suitable for the purpose specified and indicated.

1.7 MAINTENANCE SERVICE

- A. Furnish service and maintenance of treatment systems and system water for one year from date of substantial completion.
- B. Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report to Owner after each visit.
- C. Provide laboratory and technical assistance services during this maintenance period.
- D. Provide training course for Owner's personnel, instructing them on installation, care, maintenance, testing, and operation of the water treatment systems. Arrange course at startup of systems.
- E. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based on these inspections.

1.8 MAINTENANCE MATERIALS

- A. Provide sufficient chemicals for treatment and testing during warranty period.

## PART 3 - EXECUTION

### 3.1 DOMESTIC COLD WATER, HOT WATER & HOT WATER RETURN PIPING SYSTEMS

- A. Testing
  - 1. Before any fixtures are connected, hydrostatically test piping system at 1.5 times the maximum system pressure, but not less than 100 psig in excess of working pressure for (4) hours. This pressure to be on piping only, not equipment.
- B. Cleaning, flushing and disinfection.
  - 1. All domestic water piping and equipment shall be completely flushed out and disinfected before placing system in service. Disinfection procedure and results shall be in accordance with all applicable codes and State Department of Public Health. (Piping shall be flushed until water is clear).
  - 2. Ensure pH of water to be used as treatment is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or Acid (hydrochloric).
  - 3. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L (50ppm) minimum residual.
  - 4. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
  - 5. Maintain disinfectant in system for 2 hours.
  - 6. If final disinfectant residual tests less than 25 mg/L, repeat test.
  - 7. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L or 0.5 ppm maximum.
  - 8. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and water entry, and analyze in accordance with AWWA-C51.
  - 9. Verify that all tests and results are in accordance with local and state health codes and regulations.

### 3.2 SYSTEM COMPLETION CHECKLIST

- A. The checklist which follows this specification section is to be considered part of the specifications.
- B. The checklist is to be completed by the Installing Contractor and the prime Mechanical Contractor for each item as directed.

END OF SECTION

DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT  
Plumbing Systems Testing, Cleaning, Water Treatment & Startup

SYSTEMS COMPLETION CHECKLIST						
Inspection/Review Item	Notice Required	Installing Contractor		Date	Owner's Representative Signature	Remarks
		Name	Signature			
<b>Plumbing Systems</b>						
Testing of Sanitary and Storm Systems	48 hours					Tested per specification
Testing of Domestic CW, HW and HWR Piping.	48 hours					Tested per specification
Disinfection of Domestic CW, HW & HWR Piping.	48 hours					Disinfect per specification and all applicable codes.
Domestic Water Sample and Approval	When submitted					Submit sample for review and approval by local authorities.
Natural Gas Piping	7 days					Tested per specifications.
Domestic water heater system, completely installed, checked, tested and started	7 days					Verify system installation complete, operation correct. Includes verification of hot water recirculating pump system and flow balance. Check, test and startup by Manufacturer's Rep.
Valving	When completed					Verify that valves have been installed at all branch piping locations
Piping and Fitting Insulation	When Completed					Verify all piping and fitting are insulated per specification.
Reduced Pressure Backflow Preventer Tested	48 hours					Verify Reduced Pressure Backflow Preventer installed and completely operational.
Sump Pumps and Sewage Ejectors	48 hours					Verify system installation complete and operational.

By signing this form, the Contractor is certifying that he has personally witnessed completion of that item, and it is complete and complies with all respects to the drawings and specifications.

All items are to be signed off on and submitted to MacMillan Associates Inc. before a final project walk-thru by the Engineer is requested. If the Engineer discovers items incomplete and/or not in accordance with this checklist, the drawings, or the specifications, the Contractor will be backcharged for the Engineer's time and expenses.



DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT  
Plumbing Systems Testing, Cleaning, Water Treatment & Startup

SYSTEMS COMPLETION CHECKLIST						
Inspection/Review Item	Notice Required	Installing Contractor		Date	Owner's Representative Signature	Remarks
		Name	Signature			
<b>Plumbing Systems, Continued</b>						
Pipe Labeling and Valve Tagging Identification	When completed					Verify system identification is complete per specification and valve chart submitted.
Owner's Training	7 days					Verify that Owner has been instructed on operation and maintenance of systems.

By signing this form, the Contractor is certifying that he has personally witnessed completion of that item, and it is complete and complies with all respects to the drawings and specifications.

All items are to be signed off on and submitted to MacMillan Associates Inc. before a final project walk-thru by the Engineer is requested. If the Engineer discovers items incomplete and/or not in accordance with this checklist, the drawings, or the specifications, the Contractor will be backcharged for the Engineer's time and expenses.

SECTION 22 05 53

PLUMBING SYSTEM IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Medical Gas Systems: Supply of pipe labels for placement by this Section.

1.3 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use:

- A. ANSI or equal standards for the Identification of Piping Systems.

1.4 SUBMITTALS

- A. Submit list of working, symbols, letter size, and color coding for mechanical identification.
- B. 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.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color. Furnish and install on all mechanical equipment.

2.2 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1½ inch diameter with smooth edges.
- B. Chart: Typewritten letter size list in anodized aluminum frame.

DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT  
Plumbing System Identification

## 2.3 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
  - 1.  $\frac{3}{4}$  to  $1\frac{1}{4}$  inch Outside Diameter of Insulation or Pipe: 8 inch long color field,  $\frac{1}{2}$  inch high letters.
  - 2.  $1\frac{1}{2}$  to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field,  $\frac{3}{4}$  inch high letters.
  - 3.  $2\frac{1}{2}$  to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field,  $1\frac{1}{4}$  inch high letters.
  - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field,  $2\frac{1}{2}$  inch high letters.
  - 5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field,  $3\frac{1}{2}$  inch high letters.
  - 6. Ductwork and Equipment:  $2\frac{1}{2}$  inch high letters.
- B. Stencil Paint shall be semi-gloss enamel, colors conforming to ASME A13.1.

## 2.4 PIPE MARKERS

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

## 2.5 CEILING TACKS

- A. Description: Steel with  $\frac{3}{4}$  inch diameter color coded head.
- B. Color code as follows:
  - 1. Green - Plumbing valves

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces as required by manufacturer's installations for stencil painting.

DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT  
Plumbing System Identification

3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify each piece of equipment with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- G. Identify valves in main and branch piping with tags.
- H. Identify piping, concealed or exposed, with plastic tape pipe markers or stenciled painting. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 10 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- I. Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 22 06 00

PLUMBING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General information for piping systems, plumbing fixtures, backflow preventers, water heaters, sump and sewage pumps, etc. and general installation information.

1.2 FIELD MEASUREMENTS

- A. Field verify all equipment and fixture locations.
- B. Confirm that mill work is constructed with adequate provisions for the installation of countertop plumbing fixtures.
- C. Confirm all mounting heights and locations of plumbing fixtures to meet all barrier free and American Disabilities Act codes and regulations.

1.3 EQUIPMENT, FIXTURE & MISCELLANEOUS SPECIFICATIONS

- A. All equipment, plumbing fixtures, specialties, etc. that have been scheduled on drawings shall have the manufacturer's specification automatically included as part of this specification. All "approved substitute" or "voluntary alternate" equipment fixtures, etc. shall meet the capacities, quality, etc. of the scheduled items specification and capacities.

PART 2 PRODUCTS

2.1 PIPE AND PIPE FITTINGS

- A. See Section 22 10 00 for Plumbing Piping.

2.2 MATERIALS AND FINISH

- A. Fixtures shall be of best quality vitreous china, acid resisting enameled cast iron or stainless steel, free from discoloration, chips, dents, warps, flaws, cracks, scratches, etc. or other blemishes. All vitreous china and enamel shall be white unless otherwise noted. Fixtures shall have manufacturer's guarantee label or trademark indicating first quality.
- B. All exposed pipe, fittings, traps, wastes, faucets, valves, handles, escutcheons, bolts, screws and accessories shall be polished chrome plated brass unless noted otherwise. Exposed traps shall be chrome plated brass, adjustable with cleanout plug and escutcheon.

2.3 PLUMBING FIXTURES - GENERAL

- A. Furnish all fixtures as shown and scheduled on drawings.

DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT  
Plumbing Specialties

- B. Unless noted as “no substitutions”, similar fixtures by the following manufacturers with equal or better qualities will be accepted as equal for:
  - 1. Drainage Specialties - Josam, Sioux Chief, Smith, Wade, Watts, Zurn
  - 2. Plumbing Fixtures - American Standard, Bradley, Crane, Elkay, Fiat, Florestone, Just, Kohler, Mansfield, Moen Commercial, ProFlo, Sloan, Stern-Williams, Zurn.
  - 3. Plumbing Specialties – Schier, Watts, Wilkins, Zurn.
  - 4. Flush Valves - Delany, Delta, Sloan (Royal), Zurn, American Standard.
  - 5. Faucets - American Standard, Chicago, Delta, Sloan, T & S, Woodford, Zurn.
  - 6. Toilet Seats - Bemis, Centoco, Church, Olsonite, Kohler.
  - 7. Mixing Valves and Accessories - Powers, Symmons, Watts, Zurn, Reliance, Conbraco Appollo.
    - a. See 2.22 (this section) for emergency showers and eyewash stations.
  - 8. Electric Water Coolers and Drinking Fountains: Elkay, Halsey Taylor, Haws, Oasis.
- C. Provide all chair carriers, mounting hardware, etc. as required by the plumbing fixtures and wall construction. Where fixtures are located on walls, furnish and install suitable steel shapes well anchored in place and supported from floor as necessary to support fixtures. Each fixture shall be supported solidly and shall be sufficiently strong to withstand severe usage.
- D. Where plumbing fixtures occur in walls with pipe spaces in back of same, the supports for fixtures shall consist of chair carriers built into the wall with bolt projecting through face of wall for attachments of fixture brackets.

## 2.4 BACKFLOW PREVENTER

- A. Furnish and install type and quantity as shown on drawings or required by code. The Mechanical Trades shall furnish certification of all backflow preventers.
- B. Reduced Pressure Backflow Preventers: ANSI/ASSE 1013 and AWWA C506; bronze body with bronze and plastic internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve which opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer and four test cocks.
- C. Double Check Valve Assemblies: ANSI/ASSE 1012 and AWWA C506; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

## 2.5 WATER HAMMER ARRESTORS

- A. Furnish and install on systems as required by local and state plumbing codes, latest edition.
- B. ANSI A112.26.1; sized in accordance with PDI WH-201, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psig working pressure.

DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT  
Plumbing Specialties

2.6 DOMESTIC WATER HEATER

- A. Refer to drawings and furnish all.

PART 3 EXECUTION

3.1 PREPARATION

- A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert and rim elevations.
- B. Coordinate all rough-in and/or final connections to equipment and plumbing fixtures. Plumbing fixtures shall be located as required to meet all barrier free and American Disabilities Act codes and regulations.
- C. Coordinate all piping invert elevations, location, routing, etc. to allow proper drainage from all plumbing fixtures to sewer mains. Verify all services existing and new for elevations, locations, etc. before commencing installation.

3.2 INSTALLATION

- A. All valves, waste and water supply piping servicing fixtures exposed beyond face of finished walls shall be brass, nickel, and chromium plated. Where fixtures are mounted in countertops and cabinet work concealing valves and piping, chrome plated brass finishes are not required.
- B. All fixtures shall be independently valved with either integral stops or brass stops.
- C. All brackets, cleats, plates, anchors, etc. required to support fixtures or piping rigidly in place shall be provided as work of this section and shall be installed behind finished walls.
- D. Flashings: Vent pipe flashings shall be by roofing contractor. Provide lead sleeves for vents.
- E. Pipe relief from backflow preventer to nearest drain.
- F. Install water hammer arrestors as required by Code, complete with means for access if so required by the Plumbing Inspector.
- G. All exposed supplies and valves in finished areas shall be brass chrome plated. Supply lines to all hanging fixtures shall be from the wall, unless otherwise noted on drawings.
- H. Install shutoff valves on all branches. All water supplies to fixtures shall have valve on supply line to the fixture.

END OF SECTION

SECTION 22 07 00

PLUMBING PIPE INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES PIPE INSULATION FOR:

- A. Domestic water piping system including cold water, hot water and hot water return.
- B. Valves and fittings.
- C. Miscellaneous.

1.2 REFERENCES

- A. Thermal insulation materials shall meet the property requirements of the following specifications as applicable to the specific product or end use:
- B. American Society for Testing of Materials Specifications:
  - 1. ASTM C547, "Standard Specification for Mineral Fiber Preformed Pipe Insulation"
  - 2. ASTM C533, "Standard Specification for Calcium Silicate Pipe & Block Insulation"
  - 3. ASTM C585, "Recommended Practice for Inner and Outer Diameters of Rigid Pipe Insulation for Nominal Sizes of Pipe and Tubing (NPS System)"
  - 4. ASTM C1136, "Standard Specification for Barrier Material, Vapor," Type 1 or 2 (jacket only)
- C. Insulation materials, including all water and vapor barrier materials, closures, hangers, supports, fitting covers, and other accessories, shall be furnished and installed in strict accordance with project drawings, plans, and specifications.

1.3 SCOPE

- A. The work covered by this specification consists of furnishing all labor, equipment, materials and accessories, and performing all operations required, for the correct fabrication and installation of thermal insulation applied to the following commercial piping systems, in accordance with the applicable project specifications and drawings, subject to the terms and conditions of the contract:
  - 1. Hot Piping – Piping system with fluids 105°F and higher.
  - 2. Cold Piping – Piping systems with fluids below 105°F. (Includes storm water systems)
- B. Insulation, vapor barriers, jacketing, hangers, supports, accessory materials, etc. shall be installed according to manufacturers recommendations.

1.4 DEFINITIONS

- A. The term "mineral fiber" as defined by the above specifications includes fibers manufactured of glass, rock, or slag processed from a molten state, with or without binder.



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1.5 SYSTEM PERFORMANCE

- A. Insulation material furnished and installed hereunder shall meet the minimum thickness requirements of Standard 90.1 (12007), "Energy Efficient Design of new Buildings" of the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) except minimum thickness shall be 1". However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.
- B. Insulation materials furnished and installed hereunder shall be Class A maximum of 25 flame spread, 35 fuel contributed and 50 smoke developed rating and shall meet the fire hazard requirements of each of the following specifications:
  - 1. American Society for Testing of Materials ASTM E84
  - 2. Underwriters' Laboratories, Inc. UL 723
  - 3. National Fire Protection Associations NFPA 255
- C. Calcium silicate products shall include a visual identification system to permit positive field determination of their asbestos-free characteristic.

1.6 QUALITY ASSURANCE

- A. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.
- B. If any insulation material has become wet because of transit or job site exposure to moisture or water, the contractor shall not install such material, and shall remove it from the job site. An exception may be allowed in cases where the contractor is able to demonstrate that wet insulation when fully dried out (either before installation, or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in all respects to new, completely dry insulation. In such cases, consult the insulation manufacturer for technical assistance.

PART 2 PRODUCTS

2.1 PIPE INSULATION ON INDOOR SYSTEMS

- A. Molded pipe insulation shall be manufactured to meet ASTM C585 for sizes required in the particular system.
- B. Molded fibrous glass pipe insulation shall comply with the requirements of ASTM C547. Heavy density Fiberglas pipe insulation with factory applied all-service jacket (ASJ) and Doublesure\* two-component adhesive closure system, or Fiberglas Pipe and Tank Insulation, heavy density fiberglass insulation with end grain adhered to ASJ all service jacket. Joints shall be sealed by butt strips having a two-component sealing system or by applying staples and pressure sensitive tape. When self-sealing lap systems are used, sufficient thickness of insulation shall be used to maintain the outer surface temperature of the operating system below +150°F. Manufacturer's data regarding

## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

### Plumbing Pipe Insulation

thickness constraints in relation to operating temperature shall be followed. When multiple layers are required, all inner layer(s) shall beunjacketed.

- C. Fittings and valves shall be insulated with preformed fiberglass fittings, fabricated sections of fiberglass pipe insulation, fiberglass pipe and tank insulation, fiberglass blanket insulation, or insulating cement. Thickness shall be equal to adjacent pipe insulation. Finish shall match that used on straight sections.
- D. Flanges, couplings, chilled water pump impeller housings, valve bonnets etc, shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with sections of insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with a suitable vapor resistant mastic.
- E. On cold systems, vapor barrier performance is extremely important. Particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. Valve stems shall be sealed with caulking to allow free movement of the stem but provide a seal against moisture incursion. All penetrations of the ASJ and exposed ends of insulation shall be sealed with vapor barrier mastic.
- F. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access.
- G. All insulated, exposed piping inside the building within 8'-0" above the floor shall be additionally jacketed with a multi-ply, fabric reinforced, self adhesive insulation cladding material with a vapor barrier and a thickness of 0.015". Jacketing system shall be Venture Clad Plus #1579CW-E or equal.

## 2.2 SUPPORT FOR PIPE WITH INSULATION

- H. All piping shall be supported in such a manner that neither the insulation nor the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing shall be such that butt joints may be made outside the hanger.
  - 1. On all size piping of cold systems, the pipe hanger saddles shall be separated away from the pipe by utilizing inserts. The vapor barrier shall be continuous, including material covered by the hanger saddle.
  - 2. On warm water piping systems 3" in diameter or less, insulated with Fiberglas insulation, may be supported by placing saddles of the proper length and spacing, as designated in Owens-Corning Pub. 1-IN-12534, under the insulation.
  - 3. For hot or cold piping systems larger than 3" in diameter, Owens-Corning Calcium Silicate pipe insulation shall be used for high density inserts. Piping saddles for piping larger than 3" shall not be in contact with the piping.
  - 4. Owens-Corning Calcium Silicate pipe insulation may be used to support the entire weight of the piping system provided the hanger saddle is designed so the maximum compressive load does not exceed 100 psi.

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5. Where pipe shoes and roller supports are required, insulation shall be inserted in the pipe shoe to minimize pipe heat loss. Where possible, the pipe shoe shall be sized to be flush with the outer pipe insulation diameter.
6. Thermal expansion and contraction of the piping and insulation system can generally be taken care of by utilizing double layers of insulation and staggering both longitudinal and circumferential joints. Where long runs are encountered, expansion joints may be required where single layers of the insulation are being used.
7. On vertical runs, insulation support rings shall be used.

## 2.3 ACCESSORY MATERIALS

- I. Accessory materials installed as part of insulation work under this section shall include (but not be limited to):
  1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes.
  2. Field-applied jacketing materials - Sheet metal, plastic, canvas, fiberglass cloth, insulating cement; PVC fitting covers.
  3. Support materials - Hanger straps, hanger rods, saddles.
- J. All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards".

## 2.4 INSULATION THICKNESSES

- K. Fittings, including valves, flanges, unions, etc. shall be insulated with the same thickness as the required pipe insulation and covered with PVC fitting cover as specified.
- L. Pipe insulation thickness shall be as follows unless noted otherwise on drawings:

<u>Piping System</u>	<u>Pipe Size</u>	<u>Insulation Thickness</u>	<u>Insulation Conductivity BTU-in H-FT<sup>2</sup>-F</u>
Domestic cold water	All sizes	1"	0.28
Domestic hot water and hot water return (140°F and under)	Up thru 1¼" 1½" and larger	1" 1½"	0.28
Domestic hot water and Hot water return (140°F to 200°F)	Up to 1¼" 1½" and larger	1 ½" 2"	0.28

## PART 3 EXECUTION

# DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

## Plumbing Pipe Insulation

### 3.1 SITE INSPECTION

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.
- C. Verify by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments that all materials and accessories to be installed on the project may comply with applicable specifications and standards and meet specified thermal and physical properties.

### 3.2 PREPARATION

- A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.
- B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation. All damaged insulation installed will be removed and replaced by the Contractor at no extra cost to the Owner.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

### 3.3 INSTALLATION

- A. General
  - 1. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
  - 2. Install insulation on piping subsequent to installation of heat tracing, painting, testing, and acceptance tests.
  - 3. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit overall piping surfaces.
  - 4. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears or other damage. All staples used on cold pipe insulation shall be coated with suitable sealant to maintain vapor barrier integrity.
- B. Fittings

## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

### Plumbing Pipe Insulation

1. Cover valves, fittings, and similar items in each piping system using one of the following:
  - a. Mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs.
  - b. Insulation cement equal in thickness to the adjoining insulation.
  - c. PVC fitting covers insulated with material equal in thickness and composition to adjoining insulation.
- C. Penetrations
  1. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise specified.
- D. Joints
  1. Butt pipe insulation against hanger inserts. For hot pipes, apply 3" wide vapor barrier tape or band over butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints, and seal joints with 3" wide vapor barrier tape or band.
  2. All pipe insulation ends shall be tapered and sealed, regardless of service.

#### 3.4 FIELD QUALITY ASSURANCE

- A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

#### 3.5 PROTECTION

- A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.
- B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

#### 3.6 SAFETY PRECAUTIONS

- A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.
- B. The insulation contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

#### 3.7 ASBESTOS INSULATION

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Plumbing Pipe Insulation

- A. Any existing asbestos insulation on existing piping, valves, equipment, etc. where tie-ins are required, shall be removed by the Owner at Owner's expense. The contractor and Architect/Engineer shall not be responsible for any cost or work involved with removal or encapsulation of asbestos insulation.

END OF SECTION

SECTION 22 10 00

PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Domestic water piping system
- B. Valves.

1.2 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use:

- A. ANSI B31.1 - Power Piping.
- B. ANSI B31.2 - Fuel Gas Piping.
- C. ANSI B31.4 - Liquid Petroleum Transportation Piping Systems.
- D. ANSI B31.9 - Building Service Piping.
- E. ASME - Boiler and Pressure Vessel Code.
- F. ASME Sec. 9 - Welding and Brazing Qualifications.
- G. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
- H. ASME B16.3 - Malleable Iron Threaded Fittings.
- I. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and 250.
- J. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings.
- K. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings
- L. ASME B16.23 - Cast Copper Alloy Solder-Joint Drainage Fittings - DWV.
- M. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes.
- N. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- O. ASTM A47 - Ferritic Malleable Iron Castings.
- P. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded.
- Q. ASTM A74 - Cast Iron Soil Pipe and Fittings.

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- R. ASTM A106 - Carbon Steel Seamless Pipe.
- S. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- T. ASTM A536 – Ductile Iron Castings.
- U. ASTM B32 - Solder Metal.
- V. ASTM B42 - Seamless Copper Pipe.
- W. ASTM B43 - Seamless Red Brass Pipe.
- X. ASTM B75 - Seamless Copper Tube.
- Y. ASTM B88 - Seamless Copper Water Tube.
- Z. ASTM B251 - Wrought Seamless Copper and Copper-Alloy Tube.
- AA. ASTM B302 - Threadless Copper Pipe (TP).
- BB. ASTM B306 - Copper Drainage Tube (DWV).
- CC. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
- DD. ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings.
- EE. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- FF. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- GG. ASTM C700 - Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
- HH. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- II. ASTM D2235 - Solvent Cement for Acrylonitrile - Butadiene - Styrene (ABS) Plastic Pipe and Fittings.
- JJ. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
- KK. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- LL. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.
- MM. ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.



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- NN. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) Composite-Sewer Piping.
- OO. ASTM D2683 - Socket-Type Polyethylene Fillings for Outside Diameter-Controlled Polyethylene Pipe.
- PP. ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- QQ. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
- RR. ASTM D2846 - Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cements and Adhesives for Potable Hot Water Systems.
- SS. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- TT. ASTM D3033 - Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- UU. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- VV. ASTM D3309 - Polybutylene (PB) Plastic Hot Water Distribution System.
- WW. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- XX. ASTM F493 - Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- YY. ASTM F891, Schedule 40 Cellular Core PVC-DWV Pipe.
- ZZ. AWS A5.8 - Brazing Filler Metal.
- AAA. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
- BBB. AWWA C110 - Ductile - Iron and Gray - Iron Fittings 3 in. through 48 in., for Water and Other Liquids.
- CCC. AWWA C111- Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.
- DDD. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- EEE. AWWA C606 – Grooved and Shouldered Joints.
- FFF. AWWA C651 - Disinfecting Water Mains.
- GGG. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- HHH. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.

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Plumbing Piping

III. CAN-3 B281 - Aluminum Drain, Waste, and Vent Pipe and Components.

JJJ. NCPWB - Procedure Specifications for Pipe Welding.

KKK. NFPA 54 - National Fuel Gas Code.

LLL. NFPA 58 - Storage and Handling of Liquefied Petroleum Gases.

### 1.3 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Welders Certification: In accordance with ASME Sec 9.
- D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- E. All castings used for coupling housings, fittings, valve bodies, etc. shall be date stamped for quality assurance and traceability.

### 1.4 DELIVERY, STORAGE, AND HANDLING

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

## PART 2 PRODUCTS

### 2.1 DOMESTIC WATER PIPING, ABOVE GRADE INSIDE BUILDING (Must be approved by governing authorities)

- A. Domestic water piping 6" and smaller shall be: Copper tubing: ASTM B88, Type L, hard drawn, seamless.
  - 1. Fittings: ASME B16.18 cast bronze tee tap or ASME B16.22 wrought copper and bronze.
  - 2. Fittings 1-1/2" and smaller: ASME B16.18 cast bronze or ASME B16.22 wrought copper, with 301 stainless steel internal components, EPDM seals, and push-to-connect ends. Victaulic Permalynx.

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Plumbing Piping

3. Joints: ASTM B32, solder, lead free Grade 95-A tin - antimony or tin and silver with melting range 430 to 535 degrees F or AWS A5BcuP silver braze.
  4. Fittings 2" and smaller: At the Contractor's option, Schedule 10S stainless steel pipe with Vic-Press 304 fittings and couplings may be used in lieu of soldered copper. The seal material shall be UL classified in accordance with ANSI/NSF61 for Potable Water service.
  5. Joints 2" thru 8" may be mechanical pipe couplings of a bolted type with a central cavity design pressure-responsive gasket along with grooved end copper or bronze fittings as available, as manufactured by Victaulic.
    - a. Copper Tube, ASTM B-88 (Type K or L) - Roll grooved only, at copper-tube dimensions. (Flaring to accommodate alternate sized couplings is not permitted).
    - b. Mechanical Couplings - Shall be Victaulic Style 607H "Installation-Ready" rigid couplings for copper consisting of a ductile iron cast housing, with offsetting angle-pattern bolt pads, a synthetic rubber gasket of a central cavity pressure-responsive design, with ASTM A449 plated nuts and bolts to secure unit together.
    - c. Coupling Housings - Shall be cast of ductile iron conforming to ASTM A-536 (Grade 65-45-12), with a copper colored enamel paint coating.
    - d. Gaskets - Shall be molded of synthetic rubber in a Flush-Seal configuration conforming to the copper tube size (CTS) outside diameter and coupling housing, of elastomers having properties as designated in ASTM D-2000. Reference shall always be made to the latest published Selection Guide for Gaskets for proper gasket selection for the intended service.
    - e. Water Service - Gasket supplied for water services from -30°F to +230°F Grade "E" EPDM compound molded of materials conforming to ASTM D-2000, designation 2CA615A25B24F17Z, recommended for hot water service within the specified temperature range, plus a variety of dilute acids, oil-free air, and many chemical services. Not recommended for petroleum services.
      - 1) Gaskets supplied with Style 607H couplings shall be grade EHP for water services from -30°F to +250°F.
      - 2) Gaskets shall be UL classified in accordance with ANSI/NSF61 for Potable Water service.
      - 3) Meets the low lead requirements of NSF-372.
    - f. Flange Adapters - Shall be Victaulic Style 641 Vic-Flange or equal adapters 2"-6", ductile iron ASTM A-536, engaging directly into roll grooved copper tube and fittings and bolting directly to ANSI Class 125 cast iron and Class 150 steel flanged components; installer to supply standard flange bolts. Flange casting shall have a corresponding gasket.
    - g. Fittings - Fittings shall be full flow (smooth turn elbows) copper fittings conforming with ASME B16.22 or cast bronze to ASME B16.18; with grooves designed to accept grooved end couplings at copper-tube dimensions. (Flaring to accommodate alternate sized couplings is not permitted). Victaulic Copper-Connection.
- B. Domestic water piping larger than 6" shall be: Steel pipe: ASTM A53, Schedule 40, galvanized.
1. Fittings: Galvanized steel.
  2. Joints: Grooved mechanical couplings.

DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT  
Plumbing Piping

3. IPS Grooved Piping System

- a. Victaulic mechanical pipe couplings, fitting, valves and other grooved components may be used as an option to welding, threading or flanged methods. All grooved components shall be of one manufacturer and shall conform to local code approval and/or as listed by ANSI B31.1, B 31.9, ASME, UL/FM IAPMO or BOC. Grooved end product manufacturer to be ISO-9001 certified.
- b. Roll or cut grooved ends as appropriate to pipe material, wall thickness, pressures, size and method of joining. Pipe ends shall be grooved in accordance with manufacturer's current listed standards conforming to ANSI/AWWA C-606.
- c. Mechanical couplings shall be Victaulic style 107H "Installation Ready" or 07 (zero-flex) or equal, rigid coupling or style HP-70 or equal rigid coupling for high pressure service. Victaulic style 177 "Installation Ready" and style 77 or 75 or equal coupling shall be used where system flexibility is desired at pumps and other mechanical equipment to reduce noise and vibration. Noise and vibration reduction is achieved by installing (3) style 77 or 75 or equal flexible couplings near the vibration source. Couplings shall be of cast ductile iron conforming to ASTM A536, grade 65-45-12.
- d. Mechanical reducing couplings shall be Victaulic style 750 or equal for pipe runs for reduction on pipe sizes 4" thru 8".
- e. Meets the low lead requirements of NSF-372.

2.2 PIPE HANGERS AND SUPPORTS

- A. Refer to Section 22 05 00.

2.3 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under:

1. Ferrous pipe: 150 psig malleable iron threaded unions.
2. Copper tube and pipe: 150 psig bronze unions with soldered joints. (Solder shall be lead free.)

B. Pipe Size Over 2 Inches:

1. Ferrous pipe: 150 psig forged steel slip-on flanges; 1/16 inch thick preformed neoprene gaskets.
2. Copper tube and pipe: 150 psig slip-on bronze flanges; 1/16 inch thick preformed neoprene gaskets.

C. Grooved and Shouldered Pipe End Couplings:

1. Unions and flanges for servicing and disconnect are not required in installations using grooved joint couplings. (The couplings shall serve as disconnect points.)
2. Housing: Two ductile iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion where required; electroplated steel bolts, nuts, and washers conforming with ASTM A449; galvanized for galvanized pipe.
3. Sealing gasket: "C" shape or FlushSeal composition sealing gasket.
4. Gaskets shall be UL classified in accordance with ANSI/NSF-61 for Potable water service.

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Plumbing Piping

5. Basis of Design: Victaulic Company, Style 607H (Installation-Ready for Copper Tubing) and Style 107H or 177 (Installation-Ready for Steel Piping).

- D. Dielectric Connections: Dielectric nipples shall be non-conducting for connection of dissimilar materials. Dielectric nipples shall be similar to Victaulic Style 647 or Style 47. A brass adapter dielectric union is not acceptable.

## 2.4 GATE VALVES

- A. Up to and including 3 Inches: Bronze body, bronze trim, non-rising stem, handwheel, inside screw, single wedge or disc, solder or threaded ends.
- B. Over 3 Inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, single wedge, flanged or grooved ends. Basis of Design: Victaulic Series 771V.

## 2.5 GLOBE VALVES

- A. Up to and including 3 Inches: Bronze body, bronze trim, rising stem, handwheel, inside screw, renewable composition disc, solder or screwed ends, with back seating capacity (repackable under pressure).
- B. Over 3 Inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

## 2.6 BALL VALVES

- A. Up to and including 3 Inches:
  1. Bronze one piece body, stainless steel ball, Teflon seats and stuffing box ring, lever handle and balancing stops, solder or threaded ends with union.
  2. Brass two piece body, chrome plated brass ball and stem, PTFE seats and seals, lever handle, and Vic-Press ends. Victaulic Series P589.
- B. Over 1-1/2 Inches: Cast ductile iron steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, or gear drive handwheel for sizes 10 inches and over, flanged or grooved ends. Basis of Design: Victaulic Series 726.

## 2.7 PLUG VALVES

- A. Up to and including 3 Inches:
  1. Elastomer coated ductile iron disc with integrally cast stem, copper-tube dimensioned grooved ends, lever handle or gear operator. Basis of Design: Victaulic Series 608.
  2. Bronze body, bronze tapered lubricated plug, teflon packing, threaded ends.
- B. Over 3 Inches:
  1. Cast iron body and lubricated plug, flanged ends.
  2. Elastomer coated ductile iron plug with integrally cast stem, ductile iron body and bonnet, welded-in nickel seat, lever handle or gear operator. Basis of Design: Victaulic Series 377.
    - a. For installation on IPS / Steel pipe sizes with Victaulic Style 307 transition coupling.

## 2.8 BUTTERFLY VALVES

- A. Bronze body
  - 1. Elastomer coated ductile iron disc with integrally cast stem, copper-tube dimensioned grooved ends, lever handle or gear operator. Basis of design: Victaulic Series 608.
  - 2. Stainless steel disc, resilient replaceable seat, threaded ends, extended neck, 10 position lever handle.
- B. Cast or ductile iron body, chrome plated ductile iron disc, resilient replaceable pressure responsive EPDM seat, wafer or lug ends or grooved ends if Victaulic grooved fittings are used, with extended neck and 10 position lever handle. (Stem shall be offset from the disc centerline to provide full 360-degree circumferential seating). Sizes 6" and larger furnish gear drive handwheel. Basis of Design: Victaulic MasterSeal™.

## 2.9 FLOW CONTROL VALVES

- A. Construction: DZR brass (Ametal) or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain.
  - 1. Body material shall be ISO 6509 compliant.
- B. Calibration: Control flow within 3.5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control.
- C. Manual (Multiple Turn Balancing Valves): Victaulic Series 786/787/78K circuit balancing valve.
- D. If called for on drawings, furnish Victaulic or Griswold flow control valve. Flow control valve shall automatically control flow rates with  $\pm 5\%$  accuracy. Valve control mechanism shall consist of a stainless steel cartridge with a ported cup and coil/helical spring to avoid corrosion. Four operating ranges shall be available with minimum range requiring less than 2 psig to actuate the mechanism. Manufacturer shall provide independent laboratory tests verifying accuracy and performance. Griswold flow control valve shall have a 5 year warrantee to guarantee all materials and workmanship. See drawings for flow rate of valve.

## 2.10 SWING CHECK VALVES

- A. Up to and including 3 Inches: Bronze swing disc, solder or screwed ends.
- B. Over 3 Inches: Iron body, stainless steel or bronze trim, swing disc, renewable disc and seat, grooved or flanged ends. Basis of Design: Victaulic Series 712.

## 2.11 SPRING LOADED CHECK VALVES

- A. Iron body, bronze trim, stainless steel spring, renewable composition disc, screwed, wafer, or flanged ends.

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- B. Ductile iron body, stainless steel spring and shaft aluminum-bronze disc with elastomer seal or elastomer coated ductile iron disc with welded-in nickel seat, grooved ends. Basis of Design: Victaulic Series 716.

2.12 RELIEF VALVES

- A. Furnish and install as shown on plans a diaphragm-assist operated bronze body ASME rated and nameplated safety relief valve with fail-safe disc to assure normal operation under emergency conditions. The valve shall have a low blowdown differential and shall be designed to relief system pressure in excess of the operating pressure specified for the system, within the maximum operating limitations of the valve. The ASME safety relief valve shall be engineered to prevent the system fluid from entering the spring chamber under normal operating conditions. The permanent valve nameplate shall display the BTUH and relief pressure ratings certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve shall be as manufactured by Bell and Gossett.

2.13 STRAINERS

- A. Size 3 inch and Under: Screwed brass body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- B. Size 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- C. Size 5 inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.
- D. Grooved-End Strainers: Size 2 inch through 12 inch, 300 psig working pressure, Y-pattern with 1/16 or 1/8 inch stainless steel perforated screen. Victaulic Series 732.

2.14 INSERTS

- A. Inserts: Malleable iron case of steel shell and expansion plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.15 CONCRETE FOR THRUST RESTRAINT AND COLLARS

- A. Concrete: Class A Concrete conforming to Divisions 500 and 700 of the SCDOT Standard Specifications.
  - 1. Compressive strength of 3,000 psi at 28 days.
  - 2. Air entrained.
  - 3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
  - 4. Maximum slump of 3.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.
  - 5. Minimum cement content of 564 pounds per cubic yard for vibrated concrete and 602 pounds per cubic yard for non-vibrated concrete.

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PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel or groove 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.
- D. Unions and flanges for servicing and disconnect are not required in installations using grooved joint couplings. (The couplings shall serve as disconnect points.)

3.3 PLUMBING PIPING INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Dielectric nipples for connection of dissimilar materials. A brass adaptor dielectric union is not acceptable.
- C. Route piping in orderly manner and maintain gradient.
- D. Install piping to conserve building space and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
  - 1. For water systems, use adequate numbers of Victaulic Style 77 flexible couplings in header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops. (In accordance with Victaulic instructions and as approved by the engineer). Where expansion loops are required, use Victaulic Style 77 couplings on the loops.
- G. Provide clearance for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.
- I. Establish elevations of buried piping outside the building to ensure not less than 4'-0" of cover for sewers and not less than 5'-6" of cover for domestic water piping.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to weld.



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- K. Provide support for utility meters in accordance with requirements of utility companies.
- L. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.
- M. Underground sewers shall be a minimum of 3" in diameter. Sewers located within building shall have a minimum slope of 1/4" per foot for piping 3" and smaller and a minimum slope of 1/8" per foot for piping 4" and larger.
- N. All junctions of drainage piping shall be made with combination "Y" and 1/8 bend fittings.
- O. Install bell and spigot pipe with bell end upstream.
- P. Terminate plumbing vents 12" minimum above roof. Furnish and install weather cap on top of all vent pipes.
- Q. Install valves with stems upright or horizontal, not inverted.
- R. Solder or "sweat" joints shall be used for all copper and brass fittings, valves and tubing, using the soldering flux and methods recommended by the manufacturer of the tubing and fittings. Solder shall be silver solder for buried piping. No lead solder shall be used on any potable water piping.
- S. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- T. Equipment using gas and related piping shall be installed in compliance with NFPA 54 and 58, as applicable.
- U. Install ductile iron pipe and fittings in accordance with AWWA C600 and manufacturer's instructions.
- V. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.
- W. Maintain minimum 10-foot horizontal separation and 18 inch vertical separation of water main from sewer piping or as required by local code.

### 3.4 PLUMBING PIPING APPLICATION

- A. Use grooved mechanical couplings and fasteners in accessible locations, risers and pipe chases with Architect/Engineer's approval.
  - 1. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative shall provide

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on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).)

- B. Install unions downstream of valves and at equipment or apparatus connections. Unions are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as unions and disconnect points).
- C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- D. Install gate, ball, or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers. All branch piping take-offs from mains, risers, or branch piping shall have valves installed to allow isolation of branch piping.
- E. Install globe, ball, or butterfly valves for throttling, bypass, or manual flow control services.
- F. Provide spring loaded check valves on discharge of water pumps.
- G. Provide plug valves in gas systems for shut-off service. Provide removable or fixed handle for each plug valve.
- H. Provide flow controls in water recirculating systems where indicated.

### 3.5 INSTALLATION OF INSERTS

- A. Install in accordance with manufacturer's instructions.
- B. Provide inserts for placement in concrete formwork.
- C. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- D. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- E. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- F. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

### 3.6 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.

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- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1½ inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat and finish paint exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed. Hangers and supports located in mechanical spaces are considered exposed.

### 3.7 ERECTION TOLERANCES

- A. Establish invert elevations, slopes for drainage to minimum 1/8 inch per foot for piping 4" and larger, 1/4" per foot for piping 3" and smaller. Maintain gradients.
- B. Slope water piping and arrange to drain at low points.

### 3.8 SERVICE CONNECTIONS

- A. Provide new sanitary and storm sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing. Contractor shall pay all fees, cost, etc. to local authorities for tap-ins, inspections, etc. as required.
- B. Provide new water service complete with reduced pressure backflow preventer, double check valve assembly or water meter with by-pass valves as required by the local authorities.
- C. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Caulk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
- D. Contractor shall pay all fees, costs, etc. to local authorities for tap-ins, inspections, etc. as required.
- E. Provide new gas service complete with gas meter and regulators. Provide regulators on each line serving gravity type appliances, sized in accordance with

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equipment. Gas company is responsible for installation of gas service and meter. Contractor shall be responsible for all coordination, etc. Contractor shall inform the gas company of gas load for service for the building and meter size by the gas company. Owner shall pay all gas company charges for gas service directly to the gas company.

3.9 POLYETHYLENE ENCASEMENT

- A. Encase Ductile Iron piping in polyethylene where indicated on drawings to prevent contact with surrounding backfill material.
- B. Install in accordance with AWWA C105, Method A.
- C. Terminate encasement 3 to 6 inches above ground where pipe is exposed.

3.10 CONCRETE THRUST RESTRAINT

- A. Provide valves, tees, bends, caps, plugs and dead ends with concrete thrust blocks as indicated on drawings.
- B. Pour concrete thrust blocks against undisturbed earth. Locate thrust blocks at each elbow or change of pipe direction to resist resultant force and so pipe and fitting joints will be accessible for repair.
- C. Do not encase fitting joints and flanges.

END OF SECTION

SECTION 23 05 00

HVAC REQUIREMENTS

PART 1 GENERAL

1.1 RELATED SPECIFICATIONS AND DOCUMENTS

- A. Drawings and related specifications for this project including General and Supplementary Conditions, Division 1, General Requirements, Instructions to Bidders, Addenda's, etc. apply to and are considered a part of Division 23 - Mechanical Work.
- B. Information in this division is intended to clarify or make additions to the requirements set forth in the General Conditions, Supplementary Conditions, and Division I of these specifications. Any conflict between this Division 23 and other sections or divisions of the specifications or drawings shall be brought to the attention of the Architect/Engineer in writing as a request for addendum prior to the bid opening.
- C. Furnish all equipment, materials, articles, items, operations or methods listed, mentioned or scheduled on drawings, these specifications, manufacturer's installation instructions and include all labor, materials, equipment and incidentals necessary for their complete installation and operation.
- D. All information contained in this section applies to all sections within Division 23 as if it was part of each section.

1.2 DRAWINGS AND SPECIFICATIONS

- A. The drawings and these specifications are intended to supplement each other and any material or labor called for in one shall be furnished even if not specifically mentioned in both. Any material or labor which is neither shown on the drawings nor listed in this specification, but is normally incurred or required for completion of work shall be furnished. If there is a discrepancy between the drawings and specifications, the more stringent of the two shall be followed.
- B. Drawings are diagrammatic and are intended to show approximate location and general arrangement of systems and equipment. No attempt has been made to show every ell, tee, etc. Drawings shall not be scaled for location of systems, equipment, etc. All dimensions whether given on drawings or scaled shall be verified in field and coordinated with all other trades and existing field conditions. Some ductwork, piping, equipment, etc. locations may require changes in location due to field conditions and coordination with other trades will be made with no additional cost to the Owner. Failure to check will be no reason for additional compensation.
- C. These drawings and the associated specifications are intended to provide complete furnishing, installation and operational HVAC systems as specified. If these drawings and associated specifications have information omitted that would not allow a completely operational system as is the intent of the Engineer, the bidder shall notify the Engineer a minimum one week prior to the bid date to allow for addenda. Once bids have been received, the Contractor shall be responsible

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for material, labor, etc., to furnish and install a completely operational mechanical system as is the intent of these drawings and associated specification.

- D. The installation of all systems, equipment, etc., is subject to clarification with submitted shop drawings and field coordination requirements. Equipment outlines shown on drawings or dimensioned on drawings are limiting dimensions. Any equipment that reduces the indicated clearances or exceeds specified or scheduled equipment dimensions shall not be used.
- E. The Architect/Engineer and Owner reserve the right to make minor changes in the location of equipment, piping, ductwork, etc. at the time of rough-in without additional cost to the Owner.
- F. The Mechanical Trades Contractor shall have completed for his portion of work, at least one installation of size and type comparable to this project and has been in satisfactory operation for at least two complete years. The Mechanical Trades Contractor shall also have a developed service department capable of negotiating service contracts with the Owner for systems herein specified.

#### 1.3 AUTOCAD BACKGROUND FILES

- A. The Contractor shall include in their bid any cost for requesting AutoCAD backgrounds for their use from the Architect or Engineer. The cost will be \$150.00 for the first plan, and \$50.00 for each additional plan that may be requested for AutoCAD use. A waiver of responsibility for the Architect and Engineer related to Contractor use of the CAD files shall be signed by the Contractor.

#### 1.4 MANUFACTURER'S SPECIFICATIONS AND CAPACITIES

- A. Some equipment, materials, etc. that are scheduled on the drawings or listed in any addenda may not be specified in this specification. The manufacturer's specification and capacities shall be considered included and part of this specification whether it is specified in this specification or noted or scheduled on the drawings. The contractor shall remove and replace any "substituted" equipment or material that has been installed or is on site, which in the opinion of the Architect/Engineer does not meet the scheduled equipment or materials manufacturer's capacities or specification at no additional cost to the Owner.

#### 1.5 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

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- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

#### 1.6 LOCAL CONDITIONS

- A. Before submitting proposals, each contractor shall examine these specifications and associated drawings, addenda, etc. and shall examine the site of the project. The bidder shall fully investigate the site of this project, investigate coordination of his work with all other trades and existing conditions and completely satisfy himself as to the conditions to which the work is to be performed before submitting his/her bid. No allowances or considerations will be given at a later date for alleged misunderstanding as to the requirements of the work, materials to be furnished, or conditions required by the nature of this project site and coordination by the neglect on the bidder's part to make such an examination and coordination.
- B. Drawings show approximate location of existing services. The mechanical and electrical trades shall check with local utility companies or municipal agencies for exact location of services which they expect to encounter. The Mechanical Trades Contractor shall be responsible for hiring a company such as "Miss Dig" to stake out and locate all utilities in areas of excavation before commencing any work. The Mechanical Trades Contractor shall verify all elevations and locations of existing underground lines which are to be connected into or routed over or under. This verification shall be done prior to beginning work at this project.

#### 1.7 QUALITY ASSURANCE

- A. All work shall be performed in accordance with all local and state codes, laws and regulations applicable to the work for this project. The contractor shall be responsible for all permits and costs for inspections, etc., and for checking with each utility company supplying service to this project and shall determine from them all, any changes in boxes, meters, valves, service, etc., and shall include all cost for inspections, revisions to services, etc. in his bid as required by local agencies, utilities, etc. No extra payment will be made for such items after the contractor submits his bid.
- B. In addition to all applicable Federal, State and local codes, the standards and codes listed below shall apply to all mechanical work. The reference to codes and standards shall be referenced to the latest edition or revision.
  - 1. Air Diffusion Council (ADC)
  - 2. Air Moving and Conditioning Assoc., Inc. (AMCA)
  - 3. American Boiler Manufacturer's Association (ABMA)
  - 4. American Gas Association (AGA)
  - 5. American National Standard Institute (ANSI)
  - 6. American Refrigeration Institute (ARI)

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7. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
  8. American Society of Mechanical Engineers (ASME)
  9. American Society for Testing materials (ASTM)
  10. American Welding Society
  11. ANSI code of Pressure Piping and Unified Pressure Vessels
  12. ASME Boiler and Pressure Vessel Code
  13. Institute of Boiler and Radiator Manuf. (IBR)
  14. National Electrical Manufacturer's Association (NEMA)
  15. Sheet Metal & Air Conditioning Contractors National Association (SMACNA)
  16. Standards of the Hydraulic Institute
  17. Underwriters' Laboratories (UL)
  18. Williams-Steiger Occupational Safety & Health Act (OSHA)
- C. In the event of conflict between drawings, codes, standards or specifications, the most stringent requirement shall apply

#### 1.8 SUBMITTALS AND SHOP DRAWINGS

- A. Submit electronic sets of complete shop drawings for all mechanical equipment and materials associated with Division 23 and associated drawings to the Architect/Engineer for review before fabrication of work or ordering of equipment. Shop drawings shall be submitted at the earliest possible time.
- B. Shop drawings shall be first reviewed by the contractor. Inaccurate shop drawings shall be corrected by the contractor to meet specifications and schedules for this project. The contractor shall then initial the shop drawings as having been reviewed before submitting to the Architect/Engineer. Shop drawings shall have, in addition to the mechanical information, the electrical requirements for minimum circuit amperes and maximum fuse size ratings of the equipment.
- C. Drawings which are rejected must be corrected and returned for Architect/ Engineer review before ordering.
- D. Furnish to the job site copies or prints of shop drawings that have been reviewed by the Engineer as soon as possible.
- E. Include a copy of each shop drawing in the Operation and Maintenance Manual.
- F. The checking and reviewing of shop drawings by the Architect/Engineer shall be construed as assisting the contractor and the Architect/Engineer's action does not relieve the contractor from the responsibility for errors or omissions which may exist thereon. The contractor shall be held responsible for errors or omissions that are discovered after approval process and must be made good by the contractor.
- G. The Sheet Metal Contractor, etc. shall include in their bid any cost for requesting AutoCAD backgrounds for their use from the Architect or Engineer at a minimum \$100.00 for the first file, and \$50.00 for each additional file that may be requested for AutoCAD use.

#### 1.9 PERMITS, INSPECTIONS AND TESTS



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- A. The Mechanical Trades Contractor shall take out all permits and arrange for necessary inspections and shall pay all assessments, fees and costs, etc., and make all tests as required by applicable codes. At the completion of the project, the Mechanical Trades Contractor shall furnish certificates of inspection and approval and secure final occupancy permit. Record copies shall be included in the Operation and Maintenance manuals.

### 1.10 RECORD DRAWINGS

- A. Maintain an up-to-date set of "record" drawings showing actual equipment, piping, duct, etc. installation locations. Exact dimensions from column lines for all concealed work and tie-ins with elevations noted shall be included.
- B. Include a set of reproducible drawings and a set of prints in each Operation and Maintenance Manual.
- C. The Engineer reserves the right to request and be furnished any additional information he deems necessary to be shown on the record drawings.

### 1.11 OWNER'S INSTRUCTIONS

- A. Upon completion of the project, the contractor shall be responsible for instructing the Owner's operating staff, in the presence of the Architect/Engineer's representative, in the proper operation and maintenance of the mechanical systems and equipment. Include a statement signed by the Owner that instructions have been given for proper operation and maintenance of the mechanical systems and equipment.

### 1.12 GUARANTEES

- A. Furnish a written guarantee, to the Architect/Engineer, that will make the contractor responsible at his own expense for any imperfections in material and/or workmanship which may develop under ordinary use within a period of one (1) year from final Owner's acceptance of the work.
- B. Furnish all written guarantees from equipment and/or material manufacturers which shall include the operating and performance conditions and capabilities upon which they are based.
- C. Permanent equipment that is used for temporary heat or cooling shall be guaranteed for one (1) year from the date of final acceptance of the project.

### 1.13 PORTABLE AND DETACHABLE PARTS

- A. Retain all portable and detachable parts of installation such as keys, spare accessories, operating manuals, etc. include in the Operation and Maintenance Manual.

### 1.14 OPERATION AND MAINTENANCE MANUALS

- A. Furnish to the Architect/Engineer two (2) copies of an approved bound (3 ring binder) book with tabs for sections covering each item of equipment. These

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notebooks shall include shop drawings, maintenance manuals, operating manuals and parts lists to instruct the Owner on proper operation and use as well as maintenance for each piece of equipment. These books shall also include contractors', subcontractors' and manufacturers' names, telephone numbers and addresses.

- B. Manuals shall also include sequence of operation, control equipment literature, wiring and control diagrams, certificates of guarantees, certificates of inspection, mechanical system test and balancing reports. The contractor shall accumulate and summarize the control and maintenance sequence in a typewritten sheet to be included in the report.
- C. The manuals must be approved by the Architect/Engineer before final payment to the contractor. The Engineer reserves the right to request and be furnished any additional information that he deems necessary to be included in the manuals.

### 1.15 RESPONSIBILITIES FOR USE OF SUBSTITUTE MATERIALS

- A. Contractor shall notify Architect/Engineer in writing at least ten (10) calendar days before bids are due for approval to use materials and/or equipment other than that which has been specified or scheduled. If substitute materials and/or equipment are approved and used, it will be this contractor's responsibility to guarantee that the items will function as the specified equipment or materials, will in no way alter the design of the structure or system, and will not require any additional mechanical work such as piping, ductwork, etc. Any additional cost required by substitute materials will be the responsibility of the contractor.
- B. It will be the contractor's responsibility, at his own expense, to remove or replace any non-approved equipment or material or any approved equipment or materials not originally specified or scheduled if equipment and materials do not meet with the satisfaction of the Architect/Engineer.
- C. It shall be the Contractor's (Mechanical Trades) responsibility to coordinate and pay for any Electrical Contractor costs due to any changes in substitute materials and/or equipment's power requirements, which differ from that shown on the design documents.
- D. No consideration will be given to requests for substitute materials because of delivery problems unless the contractor can prove that orders were placed as soon as possible after contract was awarded and that delays were not caused by submittal of unscheduled or unspecified (substituted) materials to the Architect/Engineer.

### 1.16 COST BREAKDOWN AND EQUIPMENT LIST

- A. The successful bidder shall be responsible for submitting a cost breakdown to the Architect/Engineer and Owner within ten (10) calendar days after date of request of the breakdown. During progress of the work, if changes occur which cause additional cost, the price on such items shall be broken down in accordance with the items listed in the breakdown.

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- B. The bidders shall be responsible for submitting a complete list of all equipment manufacturers, makes, models, etc. that will be used for this project with their proposal. The equipment list shall be typed on the contractor's letterhead and shall be signed by the authorized officer.

#### 1.17 MATERIALS AND EQUIPMENT

- A. Materials and equipment furnished under this project shall have a minimum warrantee of one (1) year. All materials and equipment shall be new, of first class quality and shall be furnished, delivered, erected, installed and finished in every detail and shall be so selected and arranged as to fit into the building space. All material or equipment that is not specified but necessary for this project shall be subject to the approval of the Architect/Engineer.
- B. Any materials or equipment not specified or scheduled but similar to that which has had prior approval shall be listed as a substitution and noted on the proposal form as such.
- C. The contractor shall include all miscellaneous materials and labor required to completely install and operate the mechanical systems as is intended by these drawings and specification.

#### 1.18 TEMPORARY HEATING OR COOLING OF SPACE/BUILDING DURING CONSTRUCTION

- A. It is not recommended to use HVAC equipment being furnished for the project for temporary heating and cooling of the space/building during construction. If it is necessary to utilize the HVAC equipment for tempering air, filters shall be placed at face of each return diffuser or grille. Mechanical Contractor shall be responsible for removing temporary; filters at each return diffuser, cleaning return air ductwork and installing new filters within the HVAC equipment before space/building is turned over to the Owner.

#### 1.19 SCHEDULE, COORDINATION AND INSTALLATION OF WORK

- A. The contractor shall carry on work in such a manner as to meet the dates as scheduled by the General Contractor and shall work overtime at no expense to the Owner as required to comply with the schedule. This contractor shall schedule all work with Owner and Architect/Engineer and schedule shut down of systems with Owner.
- B. Examine the site and all drawings and specifications and coordinate work with all other trades before commencing work for this project. Arrange work essentially as shown with the exact layout to be made on the job to suit actual conditions. Precise locations of equipment and materials shall be coordinated and shall be the responsibility of this contractor. Should any conflicts in location occur, and necessary deviations from drawings are required as determined by the Architect/Engineer, the contractor shall make necessary adjustments without additional cost to the Owner. Any damage to HVAC equipment due to HVAC equipment operation during construction shall be paid for by the Mechanical Contractor.

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- C. All equipment, piping, ductwork, etc. shall be located and/or routed to allow for the most convenient access for servicing.
- D. Arrange for necessary access doors, panels, etc. to allow servicing of equipment, piping, valves, fire dampers, etc. Perform any cutting and patching as required, made necessary by failure to make proper arrangements.
- E. Indicated equipment connections, sizes and locations shall be verified and connected according to manufacturer's shop drawings and installation instructions. Thoroughly investigate the space provided for equipment and connections before ordering equipment. All equipment shall be selected to fit into the space allowed, including connections with adequate space allowed for operation and maintenance.
- F. All work shall be installed in a neat and workmanlike manner, using skilled personnel thoroughly qualified in the trade or duties that they are to perform. Rough work will be rejected.
- G. Coordinate all equipment deliveries and schedules to allow timely installation. Contractor shall separate equipment into sections and reassemble in building if required by the installation at no extra cost to the Owner.
- H. Furnish a superintendent approved by the Architect/Engineer to oversee and coordinate the work to be performed with all other trades.
- I. Coordinate location of pipes, ductwork, etc. with other building components such as structural components (beams, joists, columns, etc.), electrical components (lighting, conduits, etc.) and architectural components (walls, ceilings, floors, pipe chases, roof, etc.).
- J. Before starting work, Contractor shall verify that available space for proposed pipes, ducts, equipment etc. is adequate for the intended purpose and will result in a first class installation. Irregardless of drawings, responsibility for first class operating systems rests with the Contractor.
- K. Arrange for chases, slots, openings, etc. and other building components to allow for mechanical systems installation. Coordinate cutting and patching of these components to accommodate installation. This contractor shall be responsible for accurately locating for the general trades all chases, shafts, etc. and shall be responsible for all cutting and patching if these chases were not accurate or not coordinated in time with the general trades. Coordinate installation of all sleeves in walls, on floors or other structural or architectural components.
- L. Sequence, coordinate and integrate installation of equipment and materials for efficient work flow during the project. Particular attention should be spent on larger pieces of equipment.
- M. Install equipment and materials with provisions for necessary access for service and maintenance. Allow space for removal of all parts that may require replacement or servicing.

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- N. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- O. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. When access panels are required, valves and equipment components requiring access shall be located to minimize the number of panels.
- P. Examine the work as it progresses and alert the Architect/Engineer in writing of any instances or obstructions that will prevent this contractor from performing his/her work.

#### 1.20 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Furnish and maintain a weatherproof storage facility on the site of adequate size to store miscellaneous equipment and/or materials to prevent exposure to the weather. Location of shed shall be determined by the Owner and Architect/Engineer. The Owner reserves the right to deny storage of materials or equipment in any existing or new buildings.

#### 1.21 COOPERATION WITH ARCHITECT/ENGINEER AND OTHERS

- A. Coordinate all aspects of the mechanical system installation with all other trades, existing conditions, etc.
- B. If the bidder believes that changes in design are required to meet intended design capacities and operation or material and/or equipment is obviously omitted from these specifications and drawings, the bidder shall contact the Architect/Engineer in writing at least ten (10) days before bid date. The acceptance of a bid by the Owner shall be binding and shall indicate that the bidder does not require any changes in design nor additional costs in order to meet the design and performance of the mechanical system as indicated in these specifications and drawings.

#### 1.22 WORK INVOLVING OTHER TRADES

- A. Equipment or materials specified in Division 23 may have to be installed by other trades (such as electrical trades or architectural trades) due to code requirements or union jurisdictional requirements. Where this occurs, this contractor shall include all costs required by other trades to complete the work and hire the respective trade to perform this work.

#### 1.23 PERFORMANCE DATA AND ACCESSIBILITY

- A. All performance data specified in this specification or scheduled on drawings shall be considered actual performance of the equipment after installation. The supplier and installer shall be responsible for suitable allowances to adjust equipment to

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design capacities when actual operating and installation conditions differ from drawings.

- B. All equipment and materials shall be installed to allow access for servicing and maintenance. Coordinate final location of such equipment and materials that are concealed with required access doors on panels. Allow ample space for replacement or servicing. Extend all grease fittings to an accessible location.

#### 1.24 CUTTING AND PATCHING

- A. Unless noted otherwise, the Mechanical Trades shall be responsible for all cutting, patching and associated work required under Division 23. This work shall be performed by trades normally performing this type of work except drilling of holes shall be done by the contractor requiring same. This includes replacing areas of cutting required by this work with proper reinforcing, termite shielding, materials, finishing, etc. to restore the areas to their original condition, and filling all openings around ducts, piping, etc. with approved fire retardant materials. Regardless, all drilling of holes shall be the responsibility of the Contractor requiring same.
- B. If noted on drawings that the General Trades will be responsible for all cutting and patching, it will be the Mechanical Trades responsibility to notify all General Trades during bidding of all areas requiring cutting and patching. Regardless, all drilling of holes shall be the responsibility of the contractor requiring same.

#### 1.25 WORK IN EXISTING BUILDINGS

- A. Coordinate and schedule all work in existing building with Owner and Architect/Engineer. Systems shall be kept in operation at all times if at all possible. If a system shut-down is required, the contractor shall schedule with the Owner, the time and length of shut-down. A system shall not be shut down without written permission from the Owner.
- B. All existing equipment, piping, ductwork, etc. that is to be removed shall remain the property of the Owner. The contractor shall remove and locate this material that remains the property of the Owner to a location determined by the Owner somewhere on site. If the Owner does not want to maintain possession of the removed material, the contractor shall be responsible for removing material from the site and disposing of this material as necessary to meet all codes and requirements and shall pay all costs as required for any disposal fees, inspections, permits, etc.
- C. All existing piping, equipment, etc. whether shown on drawings or not that is to be removed and/or abandoned and does not remain property of the Owner shall be removed from site.
- D. Any existing piping, valves, mechanical equipment, etc. serving the existing building which are shown or not shown on drawings and are required for systems operation shall remain in use. If these systems require relocation to allow installation of new systems, the contractor shall be responsible for relocating to an Owner and Architect/Engineer approved location. The contractor shall pay all cost for this work and include such cost in his/her bid. (As specified previously,

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contractor shall be responsible for examining site and include all cost for work required to complete this project.)

- E. When active services, etc. are encountered in this project, the contractor shall furnish and install bracing, support, etc. as required to protect and keep these services active. (As specified previously, these drawings are diagrammatical. The contractor shall be responsible for verification of all existing services, piping, equipment, etc.).

#### 1.26 ACCESS TO EQUIPMENT, HEATING COILS, VALVES, ETC.

- A. Coordinate access panels with type of construction and furnish access panels in areas that are non-accessible. Access panels shall be furnished by this contractor and installed by the General Contractor. The access panels shall be all approved, UL labeled and fire rated and shall be located and sized to allow access to equipment, heating coils, valves, fire dampers, etc.
- B. Where access panels are required, valves, equipment etc. shall be located as to require the least number of access panels.

#### 1.27 EQUIPMENT GUARDS

- A. All rotating or moving parts of equipment that are located so as to be a hazard shall be fully enclosed or properly guarded as to meet or exceed all regulations and OSHA requirements.

#### 1.28 EQUIPMENT CONNECTIONS

- A. Connections to equipment, plumbing fixtures, etc. shall be made in accordance with shop drawings, rough-in dimensions furnished by the manufacturer, codes, etc. and may vary with connections shown on drawings. The contractor shall be responsible for making connections and number of connectors as per shop drawings, codes, etc. at no additional cost to the Owner.

#### 1.29 ELECTRICAL CONNECTIONS

- A. The Electrical Trades shall be responsible for furnishing and installing all electrical equipment, wiring, etc. required for operation of mechanical equipment unless otherwise noted on the drawings. The Mechanical Trades shall furnish detailed information and wiring diagrams to the Electrical Trades for all equipment specified and/or scheduled for this project. In the event that the Mechanical Trades furnishes an "approved equal" or "alternate" that require changes in the original electrical design, the Mechanical Trades shall pay all costs to the Electrical Trades as required to make satisfactory adjustments. All electrical work shall be done in accordance with the latest edition of the National Electric Code.
- B. See the temperature control or building automation system specification (if applicable) for description of electrical contractor work and Division 23 temperature control work.

#### 1.30 MOTORS, MOTOR STARTERS AND DISCONNECTS

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- A. Unless otherwise noted on drawings, motors shall be of constant speed 1750 rpm, new NEMA Design B, 40°C rise, horse power rated, open drip-proof except TEFC in dirty atmosphere, induction type motor with service factor of 1.15 and be of sufficient capacity to continuously operate the apparatus to which it is connected under all conditions of operation without exceeding nameplate ratings.
- B. Motors shall be premium efficiency as calculated using IEEE test method 112B.
- C. Motors ½ Hp. or larger shall be three phase; motors under ½ Hp. shall be 115 volt, 60 cycle, single phase. Before ordering the motors, the contractor shall verify correct motor voltage with the Electrical Trades and field conditions.
- D. The Mechanical Trades shall furnish, for equipment under Division 23, all special switches, disconnects, starters, alternators, etc. as specified or scheduled to be factory furnished and/or factory installed with the equipment including wiring diagrams, etc. whether it is to be factory installed or field wired. All other motor starters, disconnects, etc. not noted as factory furnished shall be furnished and installed by the Electrical Trades.
- E. Starters that are to be factory furnished with equipment shall be of the combination type and shall be as specified under Electrical Trades Division. Furnish overload protection for each phase.
- F. All wiring methods and materials shall meet NEMA, National Electric Code and State of Michigan Code requirements.
- G. All displays on control panels shall be on face of the panels.
- H. Motors having V-belt shall be furnished with base slide rails or other form of adjustment.

#### 1.31 LUBRICATION AND MAINTENANCE

- A. Contractor shall maintain, oil, lubricate, etc. all equipment furnished under Division 23 until final acceptance by the Owner. Protect all bearings and shafts during installation and thoroughly grease the steel shafts to prevent corrosion. The contractor shall be responsible for any and all damage to bearings, shaft, etc. of Division 23 equipment operated or not until final acceptance by the Owner.

#### 1.32 EXCAVATION AND BACKFILLING

- A. Furnish all excavation, backfilling and removal of excess dirt to accomplish installation of Division 23 mechanical work unless otherwise noted on drawings.
- B. All excavation shall be by open cut from the surface. Contractor shall determine whether excavation shall be by machine or by hand except where existing utilities may be located where excavation shall be by hand. Contractor shall be responsible for all damage to existing facilities and services. Excavation shall be to a depth of at least 6" to allow granular bedding below pipe or duct.
- C. If for any reason the work is suspended, the contractor shall properly protect the excavation and leave the areas unobstructed.



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- D. Trench width shall allow sufficient width at centerline of pipe to allow at all times a first class construction/installation method but in no case should be less than 12" larger than the nominal pipe or duct size. This shall especially be true in areas that joints must be connected. Joint holes may have to be made with overhanging sides to make installation safe for workmen.
- E. The excavation shall be at all times finished and backfilled to the required grade after completion and approval of work. Not more than 100 feet of trench shall be excavated and open unless written approval is given by the Architect/Engineer.
- F. The subgrade shall be 4" to 6" below the pipe of granular bedding graded and tamped by hand or mechanical means to the exact elevation required at the bottom of the pipe. Granular materials shall be approved fine aggregate meeting MDOT #2NS specifications. This material shall pass a 1/2" sieve but will be retained on a #4 sieve. If poor soil conditions exist which will not give proper support to the pipe, duct or structure, furnish granular fill as required to remedy this situation and give proper support.
- G. Furnish and install properly sloped sheet piled, shored and braced in areas that the soil requires this to maintain a proper excavation and prevent any movement of earth which could in any way damage the work under construction. When removing the sheeting and bracing, special care should be taken to prevent any caving of the sides of the excavation and injury to the completed work or adjacent property.
- H. Take all necessary action to keep trenches and other excavation areas free from water at all times. Use such methods as pumping, ditching, well pointing, etc. to prevent water in trench or excavation. Dewatering of trench shall have constant supervision.
- I. Backfill excavation and trenches with approved granular material around sides of pipe and at least 12 inches above the top of the pipe laid not more than in 6 inch layers that are thoroughly tamped to 95% of its maximum density. There shall be no backfilling by any mechanical means until the granular material has been firmly tamped around the entire pipe to 12 inches above the pipe. All material used for backfilling shall be approved by the Architect/Engineer. Wherever trenching crosses walks or roadways or isolated inside of building, backfill top 6'-0" of trench with sand or bank run gravel in layers not to exceed 6 inches in depth and carefully compact by hand or machine. Do not backfill with frozen materials.
- J. No piping shall be covered until it has been tested, inspected and approved. Upon completion of backfilling, grade shall be restored in indicated elevation and left in reasonable condition for finish grade by others unless otherwise noted on drawings.
- K. Before final acceptance of work, all disturbed streets, drives, curbs, walks, parking areas, etc. shall be paved, graveled or other to as near their original condition as possible. All unused excavated material shall be removed from site if directed by the Architect/Engineer.

### 1.33 BASES AND SUPPORTS

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- A. This contractor shall be responsible for furnishing all equipment pads and supports for equipment and materials required by Division 23 unless otherwise noted on drawings.
- B. All floor mounted mechanical equipment shall have a reinforced concrete pad furnished unless otherwise noted on drawings. The concrete pads shall be tied to the building floor with expansion bolts located maximum of 4'-0" on centers with a minimum of four (4) bolts, set before pouring and concealed within the pad. The Mechanical Trades shall verify exact pad or support size with the equipment manufacturer and shall size pad with adequate area to allow sufficient room for installation of vibration isolators, equipment mounting hardware, etc. Concrete pads shall have a 45 degree bevel at the top edge. The contractor shall verify exact location of concrete pads.
- C. Furnish all steel, hanging material, rods, etc. for suspending equipment off floor unless otherwise noted on drawings for equipment to be furnished under Division 23. This includes all structural steel for supporting between beams.
- D. All support structure shall be of strength to safely withstand all stresses and loads to which they will be subjected and shall distribute load properly over the building area. Supports shall be designed to avoid undue strain to equipment and to avoid interference with piping, pipe connections, service and maintenance clearances, etc.
- E. Where equipment is to be floor mounted and requires legs, this contractor shall furnish and install structural steel members or steel pipe and fittings for legs. Fasten and brace to equipment and furnish flange at base to allow bolting to floor.
- F. Where equipment is to be ceiling or wall mounted, furnish necessary platform, structural steel, hardware, etc. as is most suitable for support of this equipment.
- G. All supports shall be approved by the Architect/Engineer.
- H. All piping, ductwork, etc. shall be suspended from structural steel members utilizing rods and approved hanger devices. Do not use metal deck for support. Beam clamps such as the Grinnell Fig. 260 or approved equal shall be used. Sheet metal "straps" shall not be used in place of rods.
- I. The mechanical trades shall be responsible for furnishing and setting in place all mechanical equipment, roof curbs and piping/duct roof curbs. The general trade shall be responsible for the roof work and associated flashing. The mechanical trade shall furnish and install treated wood base blocking as required to level curb and to match roof insulation thickness. Curb shall be as specified, or if not specified should be similar to Pate or Thy-curb with heavy gauge galvanized steel, insulated and with wood nailer. Height of curb scheduled or specified shall be height required to top of curb above finished roof. If height is not specified or noted, a minimum 12" high above finished roof will be required. (pipe support units shall be at height required). Rooftop units will be shipped knocked down with the mechanical trade responsible for assembly on site. Roof curb shall mate with unit and provide support and a watertight installation.

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1.34 SLEEVES, PLATES AND COLLARS

- A. Furnish all sleeves, plates and collars for piping, ductwork, etc. passing through walls, floor ceilings, foundations, etc. Coordinate with the General Contractor the exact location and size of required openings. No pipe or duct shall pass through a wall, floor ceiling, etc. without a sleeve. This contractor shall be responsible for sleeve locations and securing sleeves before concrete is formed.
- B. Sleeves for steel pipe shall be standard weight black steel pipe. For walls, foundations and ceilings, sleeve shall be kept flush with finished surfaces. For floors, the sleeve shall be set flush with bottom of concrete construction and be extended up  $\frac{1}{4}$ " above concrete floor. Sleeves shall be set in place before construction of walls, floors, ceilings, etc.
- C. Sleeves for copper pipe shall be type "M" hard copper tubing installed typical to that of steel pipe sleeves.
- D. Sleeves for piping shall be sized to allow insulation to run continuous through sleeve whenever possible and to allow not less than  $\frac{1}{4}$ " all around bare pipe or insulation.
- E. Sleeves for ducts passing through floors shall be 14 gauge black steel for ducts up to 24" maximum dimension, and 12 gauge black steel for ducts 25" and over maximum dimension. Sleeves shall be kept flush with the finished wall surface.
- F. Where insulated piping passes through walls or floor sleeves, furnish 22 gauge galvanized band around insulation of same length as the sleeve length. Band shall fit snugly over insulation and be held in place by steel metal collars all around insulation to cover openings.
- G. All penetration voids shall be sealed smoke tight with non-combustible materials similar to 3M or Hilti firestop systems to maintain the integrity of the fire rated structure. In a non-fire rated assembly, seal all voids with non-hardening sealant.
- H. Where bare piping 2" and smaller pass through wall or floors, furnish polished chrome plated brass escutcheons, split type. Bare piping  $2\frac{1}{2}$ " and larger that pass through walls or floor, furnish 22 gauge galvanized steel metal collars so as to cover opening.
- I. Where piping penetrates an outside wall, below grade, utilize a mechanical sleeve, similar to link-seal, with stainless steel nuts and bolts on fasteners.

1.35 RIGGING AND HOISTING

- A. Perform all required rigging, hoisting, transportation, moving, etc. of all equipment, materials, etc. to be furnished and/or installed under Division 23 whether furnished by this contractor or by the Owner or other trades.

1.36 STORAGE FACILITY

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- A. Furnish and maintain a weatherproof storage facility on the site of adequate size to store miscellaneous equipment and/or materials to prevent exposure to the weather. Location of shed shall be determined by the Owner and Architect/Engineer. The Owner reserves the right to deny storage of materials or equipment in any existing or new buildings.

### 1.37 PROTECTION FROM DAMAGE

- A. The contractor shall be responsible for all materials, equipment, etc. and all work installed by himself and shall protect it from damage until final acceptance of this project by the Owner.
- B. Furnish all coverings and protection from dirt, dust, rain, storm, heat, traffic, wear, etc. and all possible injury including that by other workmen. Any equipment, workmanship, materials, etc. damaged prior to final acceptance by the Owner of this project shall be properly repaired at no expense to the Owner.
- C. Protect all plumbing fixtures and other equipment from damage by covering or coating. Any dented, scratched, rusted or marred surface finishes will not be accepted.
- D. Protect all equipment, materials, etc. from freezing.

### 1.38 COMMON PIPE MATERIALS AND INSTALLATION INSTRUCTIONS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. Refer to individual Division 23 piping Sections for special joining materials not listed below.
  - 1. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
    - a. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
      - 1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      - 2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
  - 3. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
  - 4. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
  - 5. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

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6. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
7. Solvent Cements for Joining Plastic Piping:
  - a. ABS Piping: ASTM D 2235.
  - b. CPVC Piping: ASTM F 493.
  - c. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - d. PVC to ABS Piping Transition: ASTM D 3138.
8. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

1.39 PIPE HANGERS AND SUPPORTS

- A. Hangers and saddles shall be Modern Pipe Support Corp., Grinnell/Anvil, Autogrip, or M-CO. Inserts shall be of the type to receive a machine bolt head or nut after installation, permit horizontal adjustment, and shall be flush with the surface. For copper pipe with steel hangers, clean and wrap pipe with two layers of plastic insulating tape at point of contact. Roller supports shall be adjustable type with insulated standoff. Rods shall be used for suspended installation. Sheet metal "straps" shall not be used in place of rods.
- B. Hangers for piping with vapor barrier sealed insulation shall be multipurpose pipe saddles fitting over the insulation. Wire or perforated strap iron will not be permitted for pipe supports. Do not support hangers from roof deck. Furnish and install all support steel as required to suspend from structural steel joist or beams. Hangers shall be clevis or split ring type with vertical adjustment and beam clamp similar to Grinnell/Anvil Fig. 260, with maximum spacing per ASHRAE Standards:

Pipe Size	Steel Pipe	Copper Pipe	PVC Pipe	Rod Size
½ to ¾ inch	6 feet	5 feet	4 feet	3/8"
1 inch	7 feet	5 feet	4 feet	3/8"
1 ¼ inch	7 feet	7 feet	4 feet	3/8"
1½ inch	7 feet	7 feet	4 feet	1/2"
2 inch	10 feet	8 feet	4 feet	1/2"
2½ inch	11 feet	9 feet	4 feet	5/8"
3 inch	11 feet	9 feet	4 feet	5/8"
3 ½ inch	13 feet	11 feet	4 feet	5/8"
4 inch	14 feet	12 feet	4 feet	3/4"
5 inch	14 feet	12 feet	4 feet	3/4"
6 inch	14 feet	--	4 feet	3/4"
8 inch	16 feet	--	4 feet	7/8"
10 inch	16 feet	--	4 feet	7/8"
12 inch	20 feet	--	4 feet	1"
14 inch	20 feet	--	4 feet	1¼"
16 inch	20 feet	--	4 feet	1¼"
18 inch	20 feet	--	4 feet	1¼"

- C. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.

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- D. Hangers for Hot Pipe Sizes  $\frac{1}{2}$  to  $1\frac{1}{2}$  Inch: Malleable iron, adjustable swivel, split ring.
- E. Hangers for Cold Pipes sizes  $\frac{1}{2}$ " to  $1\frac{1}{2}$ " and Hot and Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
- F. Hangers for Hot Pipe Sizes thru 4 Inches: Carbon steel, adjustable, clevis.
- G. Hangers for Hot Pipe Sizes 5 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
- H. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- I. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
- J. Wall Support for Pipe Sizes up thru 3 Inches: Cast iron hook.
- K. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
- L. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
- M. Vertical Support: Steel riser unistrut clamps at high, mid, and low locations.
- N. Floor Support for Cold Pipe all sizes and Hot Pipe Sizes up thru 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- O. Floor Support for Hot Pipe Sizes 5 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- P. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- Q. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- R. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustments, top slot for reinforcing rods, lugs for attaching to forms, size inserts to suit threaded hanger rods.

1.40 PIPING, DUCTWORK AND EQUIPMENT SUPPORT

- A. Attachments of mechanical equipment to structural members are the responsibility of the installing trade. Structural members shall not be field cut, welded or otherwise modified without approval of the Architect/Engineer. Attachment to steel joist shall be made at panel points. When routing piping or ductwork perpendicular to joist, a support shall be provided at every steel joist; when parallel to joist, a support shall be provided at no more than 6' on centers or two panel bays.

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Structural members shall not be overloaded as a result of attachments. Attachment/equipment loading for all trades resulting in total load greater than an equivalent uniform 5 psf for any member shall be submitted to the Architect/Engineer for review. Mechanical Trades may contact the project Structural Engineer as required for panel point location assistance and welder certification requirements. Electrical Trades are still responsible for design, layout, and fabrication and installation of electrical supports and support attachment methods. Mechanical Trades shall submit attachment methods to the Structural Engineer for review.

- B. Install products in accordance with manufacturer's instructions.
- C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- D. Do not use spring steel clips and clamps.
- E. Do not use powder-actuated anchors.
- F. Do not drill or cut structural members without permission from Architect/Engineer.
- G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

### 1.41 PIPING SYSTEMS SHUT OFF VALVES

- A. Shut off valves shall be installed at all branch lines off main piping, or where mains divide/separate to serve different areas, to allow isolation of all branch piping and systems they serve such as air handling units, areas or wings of the building, etc.

### 1.42 CLEANING AND FINISHING

- A. During construction period, remove all debris, rubbish, tools, equipment, unused materials, etc. as required or requested by the Architect/Engineer. All cost for cleanup and removal will be the responsibility of the contractor.
- B. Upon completion of the project and before final acceptance by the Owner, the entire installation shall be thoroughly cleaned, all rubbish and unused material removed to the satisfaction of the Architect/Engineer. All dust and dirt shall be removed from all equipment, piping, ductwork, etc.
- C. Thoroughly clean all heating units, fans and fan wheels, diffusers and grilles, air handler plenums and air filter frames, etc. using compressed air if necessary.
- D. Finish paint all equipment, materials, piping, etc. as noted on drawings or listed in this specification. Match Owner's existing color scheme. Any Division 23 equipment which has been scratched or damaged shall be finished equal to the original finish.

### 1.43 DUCTWORK MANUAL BALANCING DAMPERS

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- A. All duct branch take off's to diffusers, grilles, regulators, etc. shall have manual balancing dampers installed to allow balancing of outlets.

1.44 EQUIPMENT/SYSTEMS START-UP

- A. Furnish and schedule manufacturer's start-up service for all equipment and systems. These start-up services shall be performed in the presence of, and to the satisfaction of the Owner and Architect/Engineer.

1.45 EQUIPMENT/SYSTEMS SIGN-OFF

- A. The Mechanical Trades shall furnish written sign-offs on all systems stating that the equipment and systems have been checked, tested, started and that their operation has been verified correct through the entire range of operation that can be expected through the seasons.

1.46 SUBSTANTIAL COMPLETION

- A. Contractor shall submit a letter to the Architect/Engineer advising that all work has been completed in accordance with plans and specifications and the project is ready for a final walk-thru.

END OF SECTION



SECTION 23 05 19  
GAGES AND METERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Positive displacement meters.
- B. Flow meters.
- C. Pressure gages and Pressure gage taps.
- D. Thermometers and thermometer wells.
- E. Static pressure gages.
- F. Filter gages.

1.2 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use:

- A. ASME - B40.1 - Gages - Pressure Indicating Dial Type - Elastic Element.
- B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.
- C. ASTM D2458 - Method of Flow Measurement by The Venturi Motor Tube.
- D. ASTM E1 - Specification for ASTM Thermometers.
- E. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.
- F. AWWA C700 - Cold Water Meters - Displacement Type.
- G. AWWA C701 - Cold Water Meters - Turbine Type for Customer Service.
- H. AWWA C702 - Cold Water Meters - Compound Type.
- I. AWWA C706 - Direct Reading Remote Registration System for Cold Water Meters.
- J. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.
- K. ISA RP 3.2 - Flange Mounted Sharp Edged Orifice Plates for Flow Measurement.
- L. UL 404 - Gages, Indicating Pressure, for Compressed Gas Service.

1.3 SCOPE

# DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

## Gages and Meters

- A. The work covered by this specification consists of furnishing all labor, equipment, materials and performing all operations required, for the correct and complete fabrication and installation of gages and meters in accordance with the applicable project specifications, drawings, codes, regulations and standards.

### 1.4 ENVIRONMENTAL REQUIREMENTS

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

## PART 2 PRODUCTS

### 2.1 POSITIVE DISPLACEMENT METERS (LIQUID)

- A. AWWA C700, positive displacement disc type suitable for fluid with bronze case and cast iron frost-proof, breakaway bottom cap, hermetically sealed register.
  - 1. Meter: Brass body turbine meter with magnetic drive register.
  - 2. Service: cold water, 122 degrees F hot water, 200 degrees F.
  - 3. Accuracy: 1½ percent.
  - 4. Maximum Counter Reading: 10 million gallons (liters).
  - 5. Size: ¾ inch.

### 2.2 HEAT CONSUMPTION METERS

- A. Meter: Brass body turbine meter with magnetic drive register, platinum temperature sensors.
  - 1. Maximum Service Temperature: 200 degrees F.
  - 2. Accuracy 1½ percent.
  - 3. Maximum Counter Reading: 1 million BTUH.
  - 4. Size: ¾ inch.
  - 5. Power 24 volt converter.

### 2.3 LIQUID FLOW METERS

- A. ASME MFC-3M, calibrated venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gage in case.

### 2.4 PRESSURE GAGES

- A. Gage: ASME B40.1, 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: 4½ inch diameter.
  - 3. Mid-Scale Accuracy: One percent.
  - 4. Scale: psi.

### 2.5 PRESSURE GAGE ACCESSORIES

- A. Gage Cock: Ball valve.

## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

### Gages and Meters

- B. Pulsation Damper: Pressure snubber, brass with 1/4 inch connection.
- C. Siphon: 1/4 inch angle or straight pattern.

#### 2.6 STEM TYPE THERMOMETERS

- A. Thermometer: ASTM E1, adjustable angle, liquid-in-glass, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.
  - 1. Size: 9 inch scale.
  - 2. Window: Acrylic.
  - 3. Stem: die-cast zinc, length to suit.
  - 4. Accuracy: ASTM E77 1 percent.
  - 5. Calibration: Both degrees F and degrees C.
  - 6. Tube: Non-toxic, blue-reading organic filled, magnifying lens front.

#### 2.7 DIAL THERMOMETERS

- A. Thermometer: ASTM E1, stainless steel case, vapor or liquid actuated with brass or copper bulb, copper or bronze braided capillary, white with black markings and black pointer glass lens.
  - 1. Size: 4½ inch.
  - 2. Lens: Clear glass Lexan.
  - 3. Length of Capillary: Minimum 5 feet.
  - 4. Accuracy: 2 percent.
  - 5. Calibration: Both degrees F and degrees C.

#### 2.8 THERMOMETER SUPPORTS

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

#### 2.9 TEST PLUGS

- A. Test Plug: Similar to Petes Plug, 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel or Viton core for temperatures up to 275 degrees F.
- B. Test Kit: Carrying case, internally padded and fitted containing two 3 1/2 inch diameter pressure gages, two gage adapters with 1/8 inch probes, two 1 1/2 inch dial thermometers.

#### 2.10 STATIC PRESSURE GAGES

- A. 3½ inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

### Gages and Meters

- B. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.
- C. Accessories: Static pressure taps with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.
- C. Provide one pressure gage per pump, installing taps on suction and discharge of pump. Pipe to gage.
- D. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage. Provide siphon on gages in steam systems. Extend nipples and siphons to allow clearance from insulation.
- E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2½ inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- F. Install thermometers in air duct systems on flanges.
- G. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets, where thermometers are provided on local panels.
- H. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.
- I. Coil and conceal excess capillary on remote element instruments.
- J. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- K. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- L. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- M. Locate test plugs adjacent to thermometers and thermometer sockets, adjacent to pressure gages and pressure gage taps, and adjacent to control device sockets.

END OF SECTION

SECTION 23 05 53  
HVAC IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Medical Gas Systems: Supply of pipe labels for placement by this Section.

1.3 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use:

- A. ANSI or equal standards for the Identification of Piping Systems.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color. Furnish and install on all mechanical equipment.

2.2 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1½ inch diameter with smooth edges.
- B. Chart: Typewritten letter size list in anodized aluminum frame.

2.3 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
  - 1. ¾ to 1¼ inch Outside Diameter of Insulation or Pipe: 8 inch long color field, ½ inch high letters.
  - 2. 1½ to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, ¾ inch high letters.
  - 3. 2½ to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1¼ inch high letters.
  - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2½ inch high letters.

## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

### HVAC Identification

5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3½ inch high letters.
6. Ductwork and Equipment: 2½ inch high letters.

B. Stencil Paint shall be semi-gloss enamel, colors conforming to ASME A13.1.

#### 2.4 PIPE MARKERS

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

#### 2.5 CEILING TACKS

- A. Description: Steel with ¾ inch diameter color coded head.
- B. Color code as follows:
  1. Yellow - HVAC equipment
  2. Red - Fire dampers/smoke dampers
  3. Green - Plumbing valves
  4. Blue - Heating/cooling valves

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces as required by manufacturer's installations for stencil painting.

#### 3.2 INSTALLATION

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

DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT  
HVAC Identification

- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify each piece of equipment with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify thermostats relating to terminal boxes or valves with nameplates.
- I. Identify valves in main and branch piping with tags.
- J. Tag automatic controls, instruments, and relays. Key to control schematic.
- K. Identify piping, concealed or exposed, with plastic tape pipe markers or stenciled painting. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 10 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- L. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- M. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.
- N. Identify access points at the exterior of all fire, smoke, or combination fire/smoke dampers with a permanent label, having letters not less than 1/2" in height, reading fire damper, smoke damper or fire/smoke damper respectively.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS AND DRAWINGS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself but is supplementary to the entire specification and drawings.

1.3 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use:

- A. AABC - National Standards for Total System Balance.
- B. ADC - Test Code for Grilles, Registers, and Diffusers.
- C. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
- D. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- E. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.4 SUBMITTALS

- A. Submit electronic draft copies of report for review prior to final acceptance of Project. Provide electronic final copies for Architect/Engineer review and for inclusion in operating and maintenance manuals.
- B. Provide reports in 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations. Binder shall be high quality hard cover type.



## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

### Testing, Adjusting, and Balancing

- C. Include detailed procedures, agenda, sample report forms and copy of NEBB Project Performance Guaranty prior to commencing system balance.
- D. Test Reports: Indicate data on AABC National Standards for Total System Balance forms or forms approved in writing by Architect/Engineer.

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations of flow measuring stations and/or balancing valves and rough setting.

#### 1.6 QUALITY ASSURANCE

- A. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. Maintain one copy of each document on site.
- C. The final air balance report shall be approved by the Architect/Engineer prior to final payment to the Contractor. The Engineer reserves the right to ask for and be furnished any additional information he deems necessary to be shown on air/water balance report.

#### 1.7 QUALIFICATIONS

- A. Agency: Independent company (not associated with the systems installing contractor) specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years experience and NEBB certified. The test and balance agency selected by the Contractor shall be approved by the Engineer. The Mechanical Trades shall be responsible for any cost differences between the test and balance agency selected by the Contractor and the test and balance agency approved by the Engineer.

#### 1.8 SEQUENCING AND SCHEDULING

- A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project. Coordinate project schedule with contractor. The Mechanical Trades shall coordinate and schedule the on-site balancing with the Engineer to allow the Engineer the ability to be at the project site during the time of the balancing. If the Engineer is not scheduled to oversee the balance of systems, the Mechanical Trades shall be responsible for rebalancing the system in the presence of the Engineer and be responsible for all costs for such.
- B. The Test and Balance Agency shall schedule/coordinate (through the Mechanical Contractor) with the Temperature Control Contractor. The Temperature Control Contractor should be on site during the air balance to verify proper operation of the system required for the air balance.
- C. Acceptable Test and Balance Contractors.
  - 1. HiTech Test and Balance (Freeland, MI)

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Testing, Adjusting, and Balancing

2. Absolute Balance Company (South Lyon, MI)
3. Enviro-Aire/Total Balance Company (St Clair Shores, MI)
4. Ener-Tech Testing (Holly, MI)
5. International Test & Balance (Southfield, MI)

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
  1. Systems are started and operating in a safe and normal condition.
  2. Temperature control systems are installed complete and operable.
  3. Proper thermal overload protection is in place for electrical equipment.
  4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  5. Duct systems are clean of debris.
  6. Fans are rotating correctly.
  7. Fire and volume dampers are in place and open.
  8. Air coil fins are cleaned and combed.
  9. Access doors are closed and duct end caps are in place.
  10. Air outlets are installed and connected.
  11. Duct system leakage is minimized.
  12. Hydronic systems are flushed, filled, and vented.
  13. Pumps are rotating correctly.
  14. Proper strainer baskets are clean and in place.
  15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- C. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

- A. Provide a review of proposed design drawings and advise appropriate trades about additional balancing devices required to attain design conditions.
- B. Advise Engineer about additional balancing devices required to attain design conditions.
- C. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply, return and exhaust systems.
- B. Air Outlets and Inlets: Adjust to within plus 10 percent and minus 5 percent of design and to Owner's satisfaction. Respond to Owner complaints of unsatisfactory room temperatures by adjusting outlets and/or inlets to more or less air as required.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

### 3.4 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- F. Check and adjust systems approximately six months after final acceptance and submit report.

### 3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities. The air balance agency shall be responsible for removing all adjustable motor pulleys and replacing them with fixed motor pulleys after air balancing the system. Include costs for all air systems to be readjusted to required air volumes. Pitot duct mains at supply air and return air ducts at air handling systems and exhaust fans to verify air quantity at units vs. at diffusers and grilles.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices at outlets to regulate air quantities so that outlets do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers in ducts.

## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
- M. Check units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- N. For variable air volume units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- O. On VAV boxes, adjust for proper operation.
- P. Advise Mechanical Contractor about additional balancing devices required to attain design conditions.
- Q. Adjust adjustable pitch sheaves to setting as required by actual conditions. If sheave size or type changes are recommended, include the recommendation in the draft copy of the report to allow the Owner to be informed of, and be responsible for, the recommendation for the change.

### 3.6 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.

## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balanced point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.
- G. Advise Mechanical Contractor about additional balancing devices required to attain design conditions.
- H. If pump impellor trimming or size change is recommended to improve reliability or reduce operating cost, include the recommendation in the draft copy of the report, to allow the Owner to be informed of, and be responsible for, the recommendation for the change.

### 3.7 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing shall include but not be limited to: Air moving equipment such as exhaust fans, air handlers, return fans, etc.; terminal devices such as grilles and diffusers, variable air volume boxes, etc.; all hydronic systems such as pumps, chillers, flow control valves, coils, etc. See drawings for equipment utilized for this project and submit applicable report forms for this project air and/or water system(s).
- B. Report Forms
  - 1. Title Page:
    - a. Name of Testing, Adjusting, and Balancing Agency
    - b. Address of Testing, Adjusting, and Balancing Agency
    - c. Telephone number of Testing, Adjusting, and Balancing Agency
    - d. Project name
    - e. Project location
    - f. Project Architect
    - g. Project Engineer
    - h. Project Contractor
    - i. Project altitude
    - j. Report date
  - 2. Summary Comments:
    - a. Design versus final performance
    - b. Notable characteristics of system
    - c. Description of systems operation sequence
    - d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
    - e. Nomenclature used throughout report

## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

- f. Test conditions
- 3. Instrument List:
  - a. Instrument
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Range
  - f. Calibration date
- 4. Electric Motors:
  - a. Manufacturer
  - b. Model/Frame
  - c. HP/BHP
  - d. Phase, voltage, amperage; nameplate, actual, no load
  - e. RPM
  - f. Service factor
  - g. Starter size, rating, heater elements
  - h. Sheave Make/Size/Bore
- 5. V-Belt Drive:
  - a. Identification/location
  - b. Required driven RPM
  - c. Driven sheave, diameter and RPM
  - d. Belt, size and quantity
  - e. Motor sheave diameter and RPM
  - f. Center to center distance, maximum, minimum, and actual
- 6. Pump Data:
  - a. Identification/number
  - b. Manufacturer
  - c. Size/model
  - d. Impeller
  - e. Service
  - f. Design flow rate, pressure drop, BHP
  - g. Actual flow rate, pressure drop, BHP
  - h. Discharge pressure
  - i. Suction pressure
  - j. Total operating head pressure
  - k. Shut off, discharge and suction pressures
  - l. Shut off, total head pressure
  - m. Heat output
- 7. Air Cooled Condenser:
  - a. Identification/number
  - b. Location
  - c. Manufacturer
  - d. Model number
  - e. Serial number
  - f. Entering DB air temperature, design and actual
  - g. Leaving DB air temperature, design and actual
  - h. Number of compressors
- 8. Cooling Coil Data:
  - a. Identification/number
  - b. Location
  - c. Service

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- d. Manufacturer
- e. Air flow, design and actual
- f. Entering air DB temperature, design and actual
- g. Entering air WB temperature, design and actual
- h. Leaving air DB temperature, design and actual
- i. Leaving air WB temperature, design and actual
- j. Water flow, design and actual
- k. Water pressure drop, design and actual
- l. Entering water temperature, design and actual
- m. Leaving water temperature, design and actual
- n. Saturated suction temperature, design and actual
- o. Air pressure drop, design and actual
- 9. Heating Coil Data:
  - a. Identification/number
  - b. Location
  - c. Service
  - d. Manufacturer
  - e. Air flow, design and actual
  - f. Water flow, design and actual
  - g. Water pressure drop, design and actual
  - h. Entering water temperature, design and actual
  - i. Leaving water temperature, design and actual
  - j. Entering air temperature, design and actual
  - k. Leaving air temperature, design and actual
  - l. Air pressure drop, design and actual
- 10. Cooling Tower:
  - a. Tower identification/number
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Rated capacity
  - f. Entering air WB temperature, specified and actual
  - g. Leaving air WB temperature, specified and actual
  - h. Ambient air DB temperature
  - i. Condenser water entering temperature
  - j. Condenser water leaving temperature
  - k. Condenser water flow rate
  - l. Fan RPM
- 11. Heat Exchanger:
  - a. Identification/number
  - b. Location
  - c. Service
  - d. Manufacturer
  - e. Model number
  - f. Serial number
  - g. Steam pressure, design and actual
  - h. Primary water entering temperature, design and actual
  - i. Primary water leaving temperature, design and actual
  - j. Primary water pressure drop, design and actual
  - k. Secondary water leaving temperature, design and actual
  - l. Secondary water flow, design and actual
  - m. Secondary water pressure drop, design and actual

12. Electric Duct Heater:
  - a. Manufacturer
  - b. Identification/number
  - c. Location
  - d. Model number
  - e. Design kW
  - f. Number of stages
  - g. Phase, voltage, amperage
  - h. Test voltage (each phase)
  - i. Test amperage (each phase)
  - j. Air flow, specified and actual
  - k. Temperature rise, specified and actual
13. Air Moving Equipment:
  - a. Location
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Arrangement/Class/Discharge
  - f. Air flow, specified and actual per pitot readings at equipment and per totaled outlets.
  - g. Return air flow, specified and actual per pitot readings at equipment and per totaled inlets.
  - h. Outside air flow, specified and actual per pitot.
  - i. External and total static pressure, specified and actual
  - j. Inlet pressure
  - k. Discharge pressure
  - l. Sheave Make/Size/Bore
  - m. Number of Belts/Make/Size
  - n. Fan RPM
14. Return Air/Outside Air Data:
  - a. Identification/location
  - b. Design return air flow
  - c. Actual return air flow per pitot readings at equipment and per totaled grilles air flow measurement
  - d. Design outside air flow
  - e. Actual outside air flow per pitot readings
  - f. Return air temperature
  - g. Outside air temperature
  - h. Required mixed air temperature
  - i. Actual mixed air temperature
  - j. Design outside/return air ratio
  - k. Actual outside/return air ratio
15. Exhaust Fan Data:
  - a. Location
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Air flow, specified and actual per pitot readings at exhaust fan and per totaled exhaust grilles or duct inlets.
  - f. Static pressure, specified and actual
  - g. Inlet pressure
  - h. Discharge pressure
  - i. Sheave Make/Size/Bore



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- j. Number of Belts/Make/Size
- k. Fan RPM
- 16. Duct Traverse:
  - a. System zone/branch and at all equipment (AHUs, RTUs, EFs, etc.)
  - b. Duct size
  - c. Area
  - d. Design velocity
  - e. Design air flow
  - f. Test velocity
  - g. Test air flow
  - h. Duct static pressure
  - i. Air temperature
  - j. Air correction factor
- 17. Duct Leak Test:
  - a. Description of ductwork under test
  - b. Duct design operating pressure
  - c. Duct design test static pressure
  - d. Duct capacity, air flow
  - e. Maximum allowable leakage duct capacity times leak factor
  - f. Test apparatus
    - 1) Blower
    - 2) Orifice, tube size
    - 3) Orifice size
    - 4) Calibrated
  - g. Test static pressure
  - h. Test orifice differential pressure
  - i. Leakage
- 18. Air Monitoring Station Data:
  - a. Identification/location
  - b. System
  - c. Size
  - d. Area
  - e. Design velocity
  - f. Design air flow
  - g. Test velocity
  - h. Test air flow
- 19. Flow Measuring Station:
  - a. Identification/number
  - b. Location
  - c. Size
  - d. Manufacturer
  - e. Model number
  - f. Serial number
  - g. Design Flow rate
  - h. Design pressure drop
  - i. Actual/final pressure drop
  - j. Actual/final flow rate
  - k. Station calibrated setting
- 20. Terminal Unit Data:
  - a. Manufacturer
  - b. Type, constant, variable, single, dual duct
  - c. Identification/number

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- d. Location
- e. Model number
- f. Size
- g. Minimum static pressure
- h. Minimum design air flow
- i. Maximum design air flow
- j. Maximum actual air flow
- k. Inlet static pressure
- 21. Air Distribution Test Sheet:
  - a. Air terminal number
  - b. Room number/location
  - c. Terminal type
  - d. Terminal size
  - e. Area factor
  - f. Design velocity
  - g. Design air flow
  - h. Test (final) velocity
  - i. Test (final) air flow
  - j. Percent of design air flow
- 22. Sound Level Report:
  - a. Location
  - b. Octave bands-equipment off
  - c. Octave bands-equipment on
- 23. Vibration Test:
  - a. Location of points:
    - 1) Fan bearing, drive end
    - 2) Fan bearing, opposite end
    - 3) Motor bearing, center (if applicable)
    - 4) Motor bearing, drive end
    - 5) Motor bearing, opposite end
    - 6) Casing (bottom or top)
    - 7) Casing (side)
    - 8) Duct after flexible connection (discharge)
    - 9) Duct after flexible connection (suction)
  - b. Test readings:
    - 1) Horizontal, velocity and displacement
    - 2) Vertical, velocity and displacement
    - 3) Axial, velocity and displacement
  - c. Normally acceptable readings, velocity and acceleration
  - d. Unusual conditions at time of test
  - e. Vibration source (if non-complying)

END OF SECTION

SECTION 23 07 19

HVAC PIPE SYSTEM INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES PIPE INSULATION FOR:

- A. Steam and condensate piping system.
- B. Valves and fittings.

1.2 RELATED SECTIONS

- A. All drawings and specification sections apply to work in this section. Furnish all items, articles, materials, equipment, operations or methods that are mentioned, listed or scheduled on drawings or are in this specification, including all labor, equipment, materials and miscellaneous incidentals necessary and/or required for the completion of this project. The work covered under this section of the specifications is in no way complete within itself, but is supplementary to the entire specification and drawings.

1.3 REFERENCES

- A. Thermal insulation materials shall meet the property requirements of the following specifications as applicable to the specific product or end use:
- B. American Society for Testing of Materials Specifications:
  - 1. ASTM C547, "Standard Specification for Mineral Fiber Preformed Pipe Insulation"
  - 2. ASTM C533, "Standard Specification for Calcium Silicate Pipe & Block Insulation"
  - 3. ASTM C585, "Recommended Practice for Inner and Outer Diameters of Rigid Pipe Insulation for Nominal Sizes of Pipe and Tubing (NPS System)"
  - 4. ASTM C1136, "Standard Specification for Barrier Material, Vapor," Type 1 or 2 (jacket only)
- C. Insulation materials, including all water and vapor barrier materials, closures, hangers, supports, fitting covers, and other accessories, shall be furnished and installed in strict accordance with project drawings, plans, and specifications.

1.4 SCOPE

- A. The work covered by this specification consists of furnishing all labor, equipment, materials and accessories, and performing all operations required, for the correct fabrication and installation of thermal insulation applied to the following commercial piping systems, in accordance with the applicable project specifications and drawings, subject to the terms and conditions of the contract:
  - 1. Hot Piping – Fluid temperature 105°F and up.
  - 2. Cold Piping – Fluid temperature below 105°F.

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HVAC Pipe System Insulation

- B. Insulation, vapor barriers, jacketing, hangers, supports, accessory materials, etc. shall be installed according to manufacturer's recommendations.

1.5 DEFINITIONS

- A. The term "mineral fiber" as defined by the above specifications includes fibers manufactured of glass, rock, or slag processed from a molten state, with or without binder.

1.6 SYSTEM PERFORMANCE

- A. Insulation material furnished and installed hereunder shall meet the minimum thickness requirements of Standard 90.1 (2007), "Energy Efficient Design of new Buildings" of the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) except minimum thickness shall be 1". However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.
- B. Insulation materials furnished and installed hereunder shall be Class A maximum of 25 flame spread, 35 fuel contributed and 50 smoke developed rating and shall meet the fire hazard requirements of each of the following specifications:
  - 1. American Society for Testing of Materials ASTM E84
  - 2. Underwriters' Laboratories, Inc. UL 723
  - 3. National Fire Protection Associations NFPA 255
- C. Calcium silicate products shall include a visual identification system to permit positive field determination of their asbestos-free characteristic.

1.7 QUALITY ASSURANCE

- A. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.
- B. If any insulation material has become wet because of transit or job site exposure to moisture or water, the contractor shall not install such material, and shall remove it from the job site. An exception may be allowed in cases where the contractor is able to demonstrate that wet insulation when fully dried out (either before installation, or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in all respects to new, completely dry insulation. In such cases, consult the insulation manufacturer for technical assistance.

PART 2 PRODUCTS

2.1 PIPE INSULATION ON INDOOR SYSTEMS

- A. Molded pipe insulation shall be manufactured to meet ASTM C585 for sizes required in the particular system.

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- B. Molded fibrous glass pipe insulation shall comply with the requirements of ASTM C547. Heavy density Fiberglas pipe insulation with factory applied all-service jacket (ASJ) and Doublesure\* two-component adhesive closure system, or Fiberglas Pipe and Tank Insulation, heavy density fiberglass insulation with end grain adhered to ASJ all service jacket. Joints shall be sealed by butt strips having a two-component sealing system or by applying staples and pressure sensitive tape. When self-sealing lap systems are used, sufficient thickness of insulation shall be used to maintain the outer surface temperature of the operating system below +150°F. Manufacturer's data regarding thickness constraints in relation to operating temperature shall be followed. When multiple layers are required, all inner layer(s) shall be unjacketed.
- C. Fittings and valves shall be insulated with preformed fiberglass fittings, fabricated sections of fiberglass pipe insulation, fiberglass pipe and tank insulation, fiberglass blanket insulation, or insulating cement. Thickness shall be equal to adjacent pipe insulation. Finish shall match that used on straight sections.
- D. Flanges, couplings, chilled water pump impeller housings, valve bonnets etc, shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with sections of insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with a suitable vapor resistant mastic.
- E. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access.
- F. All insulated, exposed piping inside the building within 8'-0" above the floor shall be additionally jacketed with a multi-ply, fabric reinforced, self adhesive insulation cladding material with a vapor barrier and a thickness of 0.015". Jacketing system shall be Venture Clad Plus #1579CW-E or equal.

## 2.2 SUPPORT FOR PIPE WITH INSULATION

- A. All piping shall be supported in such a manner that neither the insulation or the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing shall be such that butt joints may be made outside the hanger.
  - 1. On all size piping of cold systems, the pipe hanger saddles shall be separated away from the pipe by utilizing inserts. The vapor barrier shall be continuous, including material covered by the hanger saddle. Utilize a clevis style hanger with protective shield per MSS SP-69.
  - 2. On warm water piping systems 3" in diameter or less, insulated with Fiberglas insulation, may be supported by placing saddles of the proper length and spacing, as designated in Owens-Corning Pub. 1-IN-12534, under the insulation.
  - 3. For hot or cold piping systems larger than 2½" in diameter, Owens-Corning Calcium Silicate pipe insulation shall be used for high density inserts. Piping saddles for piping larger than 3" shall not be in contact with the piping. Vapor barrier shall cover inserts.

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4. Owens-Corning Calcium Silicate pipe insulation may be used to support the entire weight of the piping system provided the hanger saddle is designed so the maximum compressive load does not exceed 100 psi.
5. Where pipe shoes and roller supports are required, insulation shall be inserted in the pipe shoe to minimize pipe heat loss. Where possible, the pipe shoe shall be sized to be flush with the outer pipe insulation diameter.
6. Thermal expansion and contraction of the piping and insulation system can generally be taken care of by utilizing double layers of insulation and staggering both longitudinal and circumferential joints. Where long runs are encountered, expansion joints may be required where single layers of the insulation are being used.
7. On vertical runs, insulation support rings shall be used.

## 2.3 ACCESSORY MATERIALS

- A. Accessory materials installed as part of insulation work under this section shall include (but not be limited to):
  1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes.
  2. Field-applied jacketing materials - Sheet metal, plastic, canvas, fiberglass cloth, insulating cement; PVC fitting covers.
  3. Support materials - Hanger straps, hanger rods, saddles.
- B. All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards".

## 2.4 INSULATION THICKNESSES

- A. Fittings, including valves, flanges, unions, etc. shall be insulated with the same thickness as the required pipe insulation and covered with PVC fitting cover as specified.
- B. Pipe insulation thickness shall be as follows unless noted otherwise on drawings:

<u>Piping System</u>	<u>Pipe Size</u>	<u>Insulation Thickness</u>	<u>Insulation Conductivity BTU in H-Ft<sup>2</sup>-F</u>
Steam (0 to 15 psig)	Up thru 3"	2½"	0.3
	4" and larger	3"	
Steam (16 to 120 psig)	Up thru ¾"	3"	0.32
	1" to 1¼"	4"	
	1½" and larger	4½"	
Condensate return	Up thru 1¼"	1 ½"	0.3
	1½" and larger	2"	

# DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

## HVAC Pipe System Insulation

Note: piping located outdoors shall have the same insulation thickness as noted above.

### PART 3 EXECUTION

#### 3.1 SITE INSPECTION

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.
- C. Verify by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments that all materials and accessories to be installed on the project may comply with applicable specifications and standards and meet specified thermal and physical properties.

#### 3.2 PREPARATION

- A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.
- B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation. All damaged insulation installed will be removed and replaced by the Contractor at no extra cost to the Owner.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

#### 3.3 INSTALLATION

- A. General
  - 1. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
  - 2. Install insulation on piping subsequent to installation of heat tracing, painting, testing, and acceptance tests.
  - 3. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit overall piping surfaces.
  - 4. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears or other damage. All staples used on cold pipe insulation shall be coated with suitable sealant to maintain vapor barrier integrity.
- B. Fittings

## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

### HVAC Pipe System Insulation

1. Cover valves, fittings, and similar items in each piping system using one of the following:
  - a. Mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs.
  - b. Insulation cement equal in thickness to the adjoining insulation.
  - c. PVC fitting covers insulated with material equal in thickness and composition to adjoining insulation.
- C. Penetrations
  1. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise specified.
- D. Joints
  1. Butt pipe insulation against hanger inserts. For hot pipes, apply 3" wide vapor barrier tape or band over butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints, and seal joints with 3" wide vapor barrier tape or band.
  2. All pipe insulation ends shall be tapered and sealed, regardless of service.

#### 3.4 FIELD QUALITY ASSURANCE

- A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

#### 3.5 PROTECTION

- A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.
- B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

#### 3.6 SAFETY PRECAUTIONS

- A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.
- B. The insulation contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

#### 3.7 ASBESTOS INSULATION



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HVAC Pipe System Insulation

- A. Any existing asbestos insulation on existing piping, valves, equipment, etc. where tie-ins are required, shall be removed by the Owner at Owner's expense. The contractor and Architect/Engineer shall not be responsible for any cost or work involved with removal or encapsulation of asbestos insulation.

END OF SECTION

SECTION 23 09 13.23

SENSORS AND TRANSMITTERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Resistance temperature detector (RTD) and transmitter.
- B. Pressure sensor and transmitter.
- C. Flow sensor and transmitter.
- D. Differential pressure sensor.

1.2 ENVIRONMENTAL REQUIREMENTS

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

PART 2 PRODUCTS

2.1 RESISTANCE TEMPERATURE DETECTOR (RTD) AND TRANSMITTER

- A. Furnish and install resistance temperature detector (RTD) and transmitters of quantity, size and at locations as indicated on drawings. The RTD sensing element shall be directly mounted to a transmitter for measuring a temperature and transmitting an isolated linear 4 to 20 mA dc output for use in a standard two-wire 24V dc system. The unit shall be accurate to  $\pm 0.2\%$  of span or its span range. The span range shall be verified with the span of the operating temperature of the system.
- B. A 316 stainless steel element sheath, spring loaded into a 316 stainless steel well having a 3" lagging length and a  $\frac{3}{4}$ " NPT process connection. The unit shall have a watertight (NEMA Type 4) electrical enclosure with a  $\frac{1}{2}$ " NPT conduit connection.
- C. Sensors and transmitters shall be by ABB Kent Taylor, Bell and Gossett or approved equal.

2.2 PRESSURE SENSOR AND TRANSMITTER

- A. Furnish and install pressure gauge sensor and transmitter of quantity, size and at locations as indicated on drawings for measuring gauge pressure and transmitting an isolated linear 4 to 20 mA dc output for use in a standard two-wire 24V dc system. The unit shall be accurate to  $\pm 0.5\%$  of full span and have an adjustable span limit and withstand over ranges up to a static pressure of 100 psi with negligible change in output. (Verify span of pressure capable of system shown on drawings to be monitored for selection of full span of sensor.)

## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

### Sensors and Transmitters

- B. Pressure sensor shall have stainless steel wetted parts with ¼" NPT male process connection. Unit shall be protected against radio frequency interference and shall have a watertight (NEMA Type 4) electrical enclosure with a ½" NPT conduit connection.
- C. Sensors and transmitters shall be by ABB Kent Taylor, Bell and Gossett, Kele or approved equal.

#### 2.3 DIFFERENTIAL PRESSURE SENSOR

- A. Furnish and field mount differential pressure transmitters of quantity, size and location as indicated on plans for measuring differential pressure and transmitting an isolated linear 4 to 20 mA dc output for use in a standard two-wire 24V dc system. The unit shall be accurate to  $\pm 0.25\%$  of full span limit (as required for system) and shall withstand over ranges up to a static pressure of 200 psi with negligible change in output.
- B. The units shall have a corrosion resistant stainless steel body with ¼" N.P.T. process connections. A 3 valve bypass manifold shall be included. Unit shall be protected against radio frequency interference and shall have a watertight (NEMA Type 4) electrical enclosure with ½" N.P.T. conduit connection.
- C. Sensor and transmitters shall be by ABB Kent Taylor, Bell and Gossett or approved equal.

#### 2.4 FLOW SENSOR AND TRANSMITTER

- A. Furnish and install flow sensors and transmitters of quantity, sizes and at locations as indicated on drawings.
- B. Flow sensor shall be magnetic flow type, transmitter integral with sensor, accuracy of  $\pm 0.2\%$  of reading, 4 to 20 mA dc output for use in a standard two-wire 24V dc system.
- C. Flow sensor and transmitter shall mount directly into pipe line at any attitude, but insuring that electrodes are not in vertical plane.
- D. Unit shall have 150 psi rated carbon steel flanges, end connection with polyurethane liner and stainless steel electrodes.
- E. Flow sensor and transmitter shall be ABB Kent Taylor Magmaster.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- C. Install sensors and transmitters in locations where they are easily serviced.

DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT  
Sensors and Transmitters

- D. Locate test plugs adjacent to sensors and transmitters.
- E. Furnish and install all piping, pipe wells, mounting hardware, etc. required for installation of sensors and transmitters.

END OF SECTION

DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT  
Steam and Steam Condensate Piping

SECTION 23 22 00

STEAM AND STEAM CONDENSATE PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe and pipe fittings.
- B. Valves.
- C. Steam piping system.
- D. Steam condensate piping system.

1.2 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use:

- A. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
- B. ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- E. ASME B31.1 - Code for Power Piping.
- F. ASME B31.9 - Building Services Piping.
- G. ASTM A106B - Carbon Steel Seamless Pipe.
- H. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- I. ASTM B32 - Solder Metal.
- J. ASTM B88 - Seamless Copper Water Tube.
- K. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- L. AWS D1.1 - Structural Welding Code.
- M. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- N. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- O. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT  
Steam and Steam Condensate Piping

PART 2 PRODUCTS

2.1 STEAM PIPING (150 PSIG MAXIMUM)

- A. Piping 2" and smaller: ASTM A106B, Schedule 40, black steel, threaded and coupled.
  - 1. Fittings: Class 150, ASTM B16.3 malleable iron threaded or ASTM A234 forged steel welding type.
  - 2. Unions: Malleable iron Class 150.
  - 3. Joints: Threaded.
- B. Piping 2½" to 12": ASTM A106B, Schedule 40, black steel, plain ends beveled for welding.
  - 1. Fittings: Class 150, ASTM A234 forged steel butt welding type.
  - 2. Flanges: Class 150 Forged steel, weld neck, with 1/16 inch preformed non-asbestos graphite fiber gasket.
  - 3. Joints: Welded.

2.2 CONDENSATE RETURN PIPING (150 PSIG Maximum)

- A. Piping 2" and smaller: ASTM A106B, Schedule 80, black steel, threaded and coupled.
  - 1. Fittings: Class 150, ASTM B16.3 malleable iron or ASTM A234 forged steel welding type.
  - 2. Unions: Malleable Iron Class 150.
  - 3. Joints: Threaded.
- B. Piping 2½" to 12": ASTM A106B, Schedule 80, black steel, plain ends beveled for welding.
  - 1. Fittings: Class 150, ASTM A234 forged steel butt welding type.
  - 2. Flanges: Class 150, Forged steel, weld neck, with 1/16 inch thick preformed non-asbestos graphite fiber gasket.
  - 3. Joints: Welded.

2.3 PIPE HANGERS AND SUPPORTS

- A. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69, and MSS SP89.
- B. Hangers for Pipe Sizes up thru 4 Inches: Carbon steel, adjustable, clevis.
- C. Hangers for Pipe Sizes 5 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
- D. Multiple or Trapeze Hangers for Pipe Sizes up thru 4 inches: Steel channels with welded spacers and hanger rods.
- E. Multiple or Trapeze Hangers for Pipe Sizes 5 Inches and Over: Steel channels with welded spacers and hanger rods; cast iron roll and stand.
- F. Wall Support for Pipe Sizes up thru 3 Inches: Cast iron hook.

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### Steam and Steam Condensate Piping

- G. Wall Support for Pipe Sizes 4 to 5 Inches: Welded steel bracket and wrought steel clamp.
- H. Wall Support for Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll.
- I. Vertical Support: Steel riser clamp.
- J. Floor Support for Pipe Sizes up thru 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- K. Floor Support for Pipe Sizes 5 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- L. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- M. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- N. Inserts: Malleable iron case of 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.

#### 2.4 GATE VALVES

- A. Up To and Including 2 Inches:
  - 1. Bronze body, bronze trim, screwed bonnet, rising stem, handwheel, inside screw with backseating stem, solid wedge disc, alloy seat rings, threaded ends.
- B. Over 2 Inches:
  - 1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends.

#### 2.5 BALL VALVES

- A. Up To and Including 2 Inches:
  - 1. Bronze one piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle with balancing stops, threaded.
- B. Over 2 Inches:
  - 1. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, or gear drive handwheel for sizes 10 inches and over, flanged.

#### 2.6 SWING CHECK VALVES

- A. Up To and Including 2 Inches:
  - 1. Bronze or iron body, bronze trim, bronze rotating swing disc with composition seat, solder ends.
- B. Over 2 Inches:

# DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

## Steam and Steam Condensate Piping

1. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end or ferrous pipe to be welded.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Whenever work is suspended during construction protect open ends with temporary plugs or caps.
- E. After completion, fill, clean, and treat systems.

#### 3.2 INSTALLATION AND DESCRIPTION

- A. Install in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Sleeve pipe passing through partitions, walls, and floors.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Inserts:
  1. Provide inserts for placement in concrete formwork.
  2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
  4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.
- G. Pipe Hangers and Supports:
  1. Install in accordance with ASTM B31.9, ASTM F708 and MSS SP89.
  2. Support horizontal piping as scheduled. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
  3. Place hangers within 12 inches of each horizontal elbow.
  4. Use hangers with 1½ inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.



## DELTA COLLEGE DOMESTIC WATER HEATER REPLACEMENT

### Steam and Steam Condensate Piping

5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
  6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  7. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- H. Provide clearance for installation of insulation and access to valves and fittings.
- I. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.
- J. Slope steam piping one inch in 40 feet (0.25 percent) in direction of flow. Use eccentric reducers to maintain bottom of pipe level.
- K. Slope steam condensate piping one inch in 40 feet (0.25 percent). Provide drip trap assembly at low points and before control valves. Run condensate lines from trap to nearest condensate receiver. Provide loop vents over trapped sections.
- L. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- M. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting.
- N. Install valves with stems upright or horizontal, not inverted.
- O. When more than one piping system material is selected, ensure systems components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.
- P. Use unions, flanges, and downstream of valves and at equipment or apparatus connections. Use dielectric unions where joining dissimilar materials. Do not use direct welded or threaded connections.
- Q. Provide pipe hangers and supports in accordance with ASTM B31.9 and MSS SP69 unless indicated otherwise.
- R. Use gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers. All branch piping from mains, risers or branch piping shall have valves installed to allow isolation of branch piping and equipment/areas being served.
- S. Use gate or ball valves for throttling, bypass, or manual flow control services.

### 3.3 TESTING

- A. Hydrostatically test piping at 100 psi for four (4) hours. This pressure shall be on piping only, not on equipment.

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Steam and Steam Condensate Piping

END OF SECTION

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STEAM AND STEAM CONDENSATE SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Steam traps.
- B. Steam air vents.
- C. Pressure reducing valves.
- D. Steam safety valves.
- E. Steam condensate meters.
- F. Trap leak detection chamber and indicator.
- G. Condensate Receiver Unit
- H. Semi-instantaneous water heater

1.2 REFERENCES: Material and/or equipment specified in this section shall meet or exceed one or more of the property requirements or installation requirements of the following specifications/publications as applicable to the specific product or end use.

- A. ASME - Boiler and Pressure Vessel Codes, SEC 8-D - Rules for Construction of Pressure Vessels.
- B. ASME B31.9 - Building Services Piping.
- C. ASTM A105 - Forgings, Carbon Steel, for Piping Components.
- D. ASTM A126 - Grey Iron Castings for Valves, Flanges, and Pipe Fittings.
- E. ASTM A216 - Steel Casings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
- F. ASTM A395 - Ferric Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volt Maximum).
- H. NFPA 70 - National Electrical Code.

1.3 SYSTEM DESCRIPTION

- A. Use Thermostatic Steam Traps for:

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### Steam and Steam Condensate Specialties

1. Steam radiation units.
  2. Convector.
  3. Unit ventilators.
  4. Other similar terminal heating units.
- B. Use Float and Thermostatic Traps for:
1. Unit heaters.
  2. Converters.
  3. Heating coils.
  4. Steam separators.
  5. Flash tanks.
  6. Steam jacketed equipment.
  7. Direct steam injected equipment.
  8. Deaerators.
  9. Absorption chillers.
  10. Process equipment.
  11. Main headers.
  12. Branch lines.
- C. Use Inverted Bucket Steam Traps for:
1. Main headers.
  2. Branch lines.
  3. Steam jacketed equipment.
  4. Direct steam injected equipment.
  5. Deaerators.
  6. Absorption chillers.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Steam Traps:
1. Select to handle minimum of two times maximum condensate load of apparatus served.
  2. Pressure Differentials:
    - a. Low Pressure Systems (5 psi and less): 1/4 psi.
    - b. Low Pressure Systems (15 psi maximum): 2 psi.
    - c. Medium Pressure Steam (25 psi maximum): 5 psi.
    - d. Medium Pressure Steam (40 psi maximum): 10 psi.
    - e. Medium Pressure Steam (60 psi maximum): 15 psi.
    - f. High Pressure Steam (100 psi maximum): 30 psi.
    - g. High Pressure Steam (150 psi maximum): 40 psi.

#### 1.5 QUALITY ASSURANCE

- A. Perform work in accordance with state or municipality standards for installation of boilers and pressure vessels.

#### 1.6 REGULATORY REQUIREMENTS

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### Steam and Steam Condensate Specialties

- A. Conform to ASME B31.9 code for installation of steam and steam condensate piping and specialties.
- B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose indicated.

## PART 2 PRODUCTS

### 2.1 INVERTED BUCKET TRAPS

- A. Trap:
  - 1. Construction: ASTM A126, cast iron body with bolted cover, brass or stainless steel bucket, stainless steel seats and plungers, and stainless steel lever mechanism with knife edge operating surfaces.
  - 2. Rating: Per system design.
  - 3. Features: Access to internal parts without disturbing piping, top test plug, bottom drain plugs.

### 2.2 FLOAT AND THERMOSTATIC TRAPS

- A. Trap:
  - 1. Construction: ASTM A126, cast iron body and bolted cover, stainless steel or bronze bellows type air vent, stainless steel or copper float, stainless steel lever and valve assembly.
  - 2. Rating: Per system design.
  - 3. Features: Access to internal parts without disturbing piping, bottom drain plug.

### 2.3 THERMODYNAMIC TRAPS

- A. Trap:
  - 1. Construction: Stainless steel body, disc, and cap.
  - 2. Rating: 300 psig WSP.

### 2.4 THERMOSTATIC TRAPS

- A. Pressure Balanced:
  - 1. Trap: ASTM A395 cast iron body and bolted or screwed cover for 225 psig WSP; stainless steel bellows, stainless steel valve and seat.
- B. Freeze Proof:
  - 1. Trap: Cast iron body for 300 psig WSP, bronze bellows, stainless steel valve and seat, external adjustment.
- C. Bi-metallic:
  - 1. Trap: ASTM A105 forged steel body and cover, for 300 psig WSP, bi-metal element with stainless steel components, integral Type 304 stainless steel strainer screen, 1/4 inch blow down valve.

### 2.5 STEAM AIR VENTS

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- A. 125 psig WSP:
  - 1. Balanced Pressure Type: Cast brass body and cover; access to internal parts without disturbing piping; stainless steel bellows, stainless steel valve and seat.
- B. 225 psig WSP:
  - 1. Balanced Pressure Type: ASTM A126 cast iron body and cover; access to internal parts without disturbing piping; phosphor bronze bellows, stainless steel valve and seat.

2.6 PRESSURE REDUCING VALVES

- A. Bronze or cast iron body, stainless or chrome steel valve spring, stem, and trim, phosphor bronze diaphragm, direct acting, threaded up to 2 inches, flanged over 2 inches.
- B. Regulators shall be of the pilot actuated, diaphragm operated type with the pilot mounted on the upper body and the diaphragm housing below. The main valve shall be single-seated with stainless steel trim, and the valve body shall be cast iron.
- C. The main valve seat and plug shall be completely replaceable. Travel of the main valve seat shall be controlled by internal positive stops and shall be automatically set by the control stem.
- D. The main valve control stem shall be internally guided and pressure shall be positively communicated between the outlet and the upper diaphragm chamber. The diaphragm shall be of 2-ply construction.
- E. Pressure Regulator
  - 1. The pressure pilot shall be capable of being mounted on the main valve and shall have hardened-corrosion resistant stainless steel seat. The pilot diaphragm shall be 2-ply construction. The pilot shall be capable of being repairable without removing from the system.
- F. Regulators shall be as manufactured by ITT Hoffman Specialty.

2.7 SAFETY RELIEF VALVES

- A. Valve: Bronze body, stainless steel valve spring, stem, and trim, direct pressure actuated, capacities ASME certified and labeled.
- B. Accessories: Drip pan elbow.

2.8 TRAP LEAK DETECTION CHAMBER AND INDICATOR

- A. Spirax/Sarco or approved equal Spira-Tec St14SG steel sensor chamber body with a stainless steel sensor and sensor gasket, furnish balancing plug to protect the sensor from dirt for each sensing chamber.

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- B. Furnish one Spira-Tec Type 30 indicator and indicator cable consisting of an in-line sensor chamber and a portable indicator box and cable. Hand held indicator box shall have positive colored pass and fail lights, and internal circuit check facility and be UL listed for safe use in hazardous locations. Cable length shall be 4 feet.

2.9 CONDENSATE RECEIVER UNIT

- A. Furnish and install according to plans and manufacturer's instructions and the quantity of duplex condensate units as shown on the drawings. Each unit shall consist of (1) cast iron receiver, (2) water pumps, (2) float switches and all accessories as hereafter specified.
- B. The condensate receiver shall be of close grained cast iron construction (warranted for 20 years from date of shipment against failure due to corrosion), and shall be equipped with: (2) externally adjustable 2-pole float switches, water level gauge, dial thermometer, (2) pressure gauges for pump discharge, (2) bronze fitted isolation valves between pumps and receiver, and (2) lifting eye bolts. Receiver shall have an inlet, vent and an overflow opening to provide means of secondary venting.
- C. A cast iron inlet strainer with vertical self-cleaning bronze screen and large dirt pocket shall be mounted on the receiver. The screen shall be easily removable for cleaning, requiring no additional floor space for servicing.
- D. The centrifugal water pumps shall be flange mounted on the receiver. Pumps shall be close coupled vertical design, permanently aligned, bronze fitted and be equipped with stainless steel shaft, enclosed bronze impeller, and renewable bronze case ring. Carbon/ceramic mechanical seals shall be rated for 250°F for maximum life. Each pump shall be close coupled to a vertical drip proof motor. Pump capacities, motor HP and RPM, electrical characteristics, and receiver shall be as scheduled on the drawings. Each pump gpm shall be sized for 2 times the system return rate.
- E. The unit manufacturer shall furnish, mount on the unit, and wire a NEMA 2 control cabinet with drip lip and piano hinged door enclosing the following:
  - (2) Combination magnetic starters (each having 3 overload relays) with fused disconnect and cover interlock for each motor.
  - (1) Electrical alternator.
  - (2) "Auto-Off-Hand" selector switches.
  - (1) Numbered terminal strip.
  - (1) Fused control circuit transformer for each motor when the motor voltage exceeds 230 volts.
- F. All control cabinet components shall be UL Listed or recognized and NEMA rated. The control panel assembly shall be listed by Underwriters' Laboratories, Inc.
- G. Each pump control circuit shall be completely independent of the other. The electrical alternator shall change the operating sequence automatically after each cycle.

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### Steam and Steam Condensate Specialties

- H. Simultaneous operation under peak load conditions, and operation of the second pump, should the first pump or its control fail, shall be provided by the lag float switch.
- I. All factory installed wiring shall be numbered for easy identification and the numbers shall coincide with those shown on the wiring diagrams. All interconnecting wiring between the pump, controls and control panel shall be enclosed in liquid tight flexible conduit.
- J. The unit shall be factory tested as a complete unit. The pump manufacturer shall furnish complete elementary and connection wiring diagrams, piping diagrams, installation and operation instructions.
- K. Unit shall be a Domestic® Series CC™ as manufactured by Bell and Gossett, ITT Fluid Technology Corporation, Morton Grove, IL.

#### 2.10 SEMI-INSTANTANEOUS PACKAGED WATER HEATER

- A. See drawing equipment schedule.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Steam Traps:
  - 1. Provide minimum 3/4 inch size on steam mains and branches.
  - 2. Install with union or flanged connections at both ends.
  - 3. Provide gate valve and strainer at inlet, and gate valve and check valve at discharge.
  - 4. Provide minimum 10 inch long, line size dirt pocket between apparatus and trap.
- C. Remove thermostatic elements from steam traps during temporary and trial usage, and until system has been operated and dirt pockets cleaned of sediment and scale.
- D. In high pressure and medium pressure mains, provide 3/4 inch nipple in bottom of main, extending 3/4 inch into and above bottom of pipe. Provide dirt pocket with 1/2 inch high pressure thermostatic trap.
- E. Provide pressure reducing stations with pressure reducing valve, valved bypass, strainer and pressure gage on upstream side, relief valve and pressure gage on downstream side of pressure reducing valve.
- F. Pressure reducing station, when required or indicated on drawings, shall be one or two stages as indicated, to produce flat reduced pressure curve over range of capacity. Locate pilot operator control minimum 6 feet downstream of valve.



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- G. Rate relief valves for pressure upstream of pressure reducing station, for full operating capacity. Set relief at maximum 20 percent above reduced pressure.
- H. Terminate relief valves to outdoors 2 feet minimum above roof. Provide drip pan elbow with drain connection to nearest floor drain.
- I. When several relief valve vents are connected to a common header, header cross section area shall equal sum of individual vent outlet areas.

3.2 TESTING

- A. Hydrostatically test piping at 100 psi for four (4) hours. This pressure shall be on piping only, not on equipment.

END OF SECTION