High Temperature Water Distribution

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<td>Supports</td>
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<td>Temperature Controller</td>
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<tr>
<td>Shop Drawings</td>
<td></td>
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<tr>
<td>Specifications</td>
<td></td>
</tr>
</tbody>
</table>
SECTION 1 - SCOPE OF WORK

Work of this division consists of furnishing all labor, equipment, methods, and materials and performing all operations for extension of the existing high temperature water distribution system and installation of heat exchange equipment, in accordance with the Engineer’s specifications and applicable drawings.

Typical work to be performed includes the following:

1. Extend high temperature water distribution piping from the existing heat source to the future conversion room. Work shall include pipe, fittings, anchors, pipe supports, insulation, and insulating conduits. Utility tunnels shall be used whenever possible for high temperature water distribution.

2. Placement of all high temperature water (HTW) equipment and pipe supports.

3. Pipe and equipment insulation.

4. Drains, ventilation, lighting, and facilities for conversion rooms.

5. Painting and identification of all equipment, piping, insulation, and structure.

The mechanical drawings shall show the general arrangement of all piping, equipment, etc., and shall be followed, as closely as actual building construction and the work of other trades will permit. The architectural and structural drawings shall be considered as a part of the specifications insofar as these drawings furnish the Contractor with information relating to design and construction of the facilities. Architectural drawings shall take precedence over mechanical drawings. Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings, valves, and accessories as may be required to meet such conditions.

The Contractor shall submit complete detailed shop drawings of the equipment design and arrangement for the Architect and Owner’s approval (2 copies) for certain equipment listed below. These drawings must show piping arrangements and sizes, clearances, location of gauges, test cocks, etc., and all other pertinent information necessary for proper selection and installation. Equipment must fit into the available space with allowances for operation, maintenance, etc. The following equipment is involved:

1. High Temperature Water heat exchangers and supports.
2. Relief valves and safety valves.
3. Gate, globe and angle valves.
4. Air compressors.
5. Compressed air driers.
6. HTW control panel boards.
7. BTU meters and steam flow meters.
8. Sump pumps.
10. HTW pipe and fittings.
The Contractor shall furnish the Owner complete printed and illustrated operating and maintenance instructions as specified in the General Conditions, covering all units of mechanical equipment herein specified, together with parts lists. All literature shall be furnished in triplicate and shall be suitably bound in book form.

SECTION 2 - APPLICABLE SPECIFICATIONS

The following specification standards and publications of the issues listed below, but referred to hereafter by basic designation only, form a part of this specification:

1. American Society for Testing Materials Specifications
   A-53-57T     Welded and Seamless Steel Pipe
   ASTM-A234-57T  Welding Steel Fittings

2. American Standards Association Standards
   ASA-B16      Carbon Steel Welding Flanges and Flanged Fittings
   B16.9-1951    Steel Butt Welding Fittings

3. American Society of Mechanical Engineers Code
   Boiler Construction Code, Section IX: Standard Qualification for Welding Procedures and Welding Operator

4. American Standards Association Code
   B31.1-1955     Code for Pressure Piping (Incl. Supplement No. 1)

5. American Welding Society Standard
   B3.0-51T      Standard Qualification Procedure

   B19-1938

SECTION 3 - PIPING

Installation

Provide and erect, in a workmanlike manner, according to the best practices of the trade, all piping shown on
drawings and required for the complete installation of these systems. The piping shown on the drawings
shall be considered as diagrammatic for clearness in indicating the general run and connections, and may or
may not be shown in its true position. The piping may have to be offset, lowered, or raised as required or as
directed at the site. This does not relieve the contractor from responsibility for the proper erection of
systems of piping in every respect suitable for the work intended as described in the specifications and
approved by the architect-engineer.

Fabrication

High temperature water piping shall be cut accurately for fabrication to measurements established at the
construction site. Pipes shall be worked into place without springing and/or forcing, unless cold springing is
specified, properly clearing all windows, doors, and other openings and equipment. Cutting or other
weakening of the building structure to facilitate installation will not be permitted. All pipes shall have burrs
and/or cutting slag removed by reaming or other cleaning methods. All changes in direction shall be made
with fittings, except that bending of pipe will be permitted providing a hydraulic pipe bender is used. Bent
pipe, showing kinks, wrinkles, or other malformations, will not be acceptable. All open ends of pipes and
equipment shall be properly capped or plugged to keep dirt and other foreign materials out of the system.
Plugs of rags, cotton waste, or similar materials shall not be used for plugging. All piping shall be arranged
so as not to interfere with removal of other equipment or devices and so as not to block access to manholes,
access openings, etc. Piping shall be arranged as to facilitate removal of tube bundles. Flanges or unions, as
applicable for the type of piping specified, shall be provided in the piping at connections to all items of
equipment. All piping shall be black steel unless otherwise specified.

Concealment

No piping shall be concealed by covering conduits, expansion chambers, or molded insulating concrete
without specific permission from the Owner after inspection.

Expansion

HTW piping shall be installed to permit free expansion and contraction without damage to or stresses on
joints and hangers and to reduce strains on connected equipment to a minimum.

Branch Connections

All branch connections from both high temperature water flow and return mains shall be made at an angle of
45 degrees with the main in the direction of flow, unless otherwise specified or shown on the drawings.
Connections shall be carefully made to ensure unrestricted circulation, elimination of air pockets and permit
the complete drainage of the system.
HTW PIPE MATERIALS

Pipe Specifications

High temperature water supply and return piping, 2-1/2 inches and larger, shall be seamless steel pipe, schedule 40 ASTM, Spec. A-53, grade B. All threaded pipe and all pipe 2 inches and smaller in diameter shall be electric resistance welded schedule 80 ASTM, A-53, grade A. Line pipe shall not be used. Pipe and fittings shall be manufactured in the United States.

Welded Fittings

HTW pipe fittings 2 inch and larger shall be seamless, butt welding type, long radium pattern, of the same material and thickness as the pipe and conform to ASTM Spec. A-234, grade B for welding steel fittings. Fittings 1 inch to 1 ½ inches shall be schedule 80 socket weld. Fittings 3/4 inch and smaller shall be 3,000 lb. forged steel, screwed or socket weld type. Equipment connections 1 inch or larger shall be flanged. Equipment and valve connections 3/4 inch and smaller shall be socket welded or screwed, with unions to facilitate dismantling the pipe.

Pipe Flanges

Flanges shall be ASME Series 300 lb. forged steel, welded neck type, or slip-on type with 1/16 inch raised face. Slip-on flanges shall be used only where required by space limitations.

Flange Studs

Flanges shall be bolted with alloy steel studs conforming to ASTM, A-193, grade B7, class 7 fit, and threaded full length and complete with 2 heavy pattern, semi-finished, carbon steel, heat treated, hexagon nuts conforming to ASTM, A-194, class 2H.

Flange Gaskets

Gaskets for high temperature water piping flanges shall be spiral wound type 304 stainless steel, 300 lb. class, as manufactured by Flexittalic Style CG, or Goetze Style 913.

Unions

Unions shall be 3,000 lb. class forged steel, either screwed or socket-weld type, with steel to steel seat and conform to ASTM Spec. A-105 grade 2, as manufactured by Porter or Vogt. Normally, unions larger than 3/4 inch shall not be used on HTW piping.
LOW PRESSURE PIPING

Intermediate pressure and temperature and low-pressure water, steam, and air piping shall be in accordance with the following schedule:

<table>
<thead>
<tr>
<th>SERVICE</th>
<th>PIPE</th>
<th>FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam - low pressure</td>
<td>Sch. 40 black steel</td>
<td>Std. wt. steel welding fittings or lb black cast iron flanged or</td>
</tr>
<tr>
<td>125 lb black cast</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screwed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steam (100-200 Psig.)</td>
<td>Sch. 40 black steel</td>
<td>St. wt. steel welding or X. H. black C. I. or steel</td>
</tr>
<tr>
<td>Low pressure condensate</td>
<td>Sch. 80 black steel</td>
<td>Extra heavy steel seamless welding</td>
</tr>
<tr>
<td>or and boiler feedwater</td>
<td>Seamless</td>
<td>black C. I. fittings</td>
</tr>
<tr>
<td>Safety valve escape pipes</td>
<td>Std. galvanized</td>
<td>Galv. 150 lb malleable iron, iron screwed</td>
</tr>
<tr>
<td>and drains</td>
<td>steel</td>
<td></td>
</tr>
<tr>
<td>Low temp. hot water</td>
<td>Sch. 40 black steel</td>
<td>Std. wt. steel welding fittings or iron flanged or screwed</td>
</tr>
<tr>
<td>125 lb black cast</td>
<td></td>
<td></td>
</tr>
<tr>
<td>140º and 180º hot</td>
<td>Type AL@ seamless</td>
<td>Solder type wrought copper</td>
</tr>
<tr>
<td>domestic water and culinary</td>
<td>hard-drawn copper</td>
<td></td>
</tr>
<tr>
<td>Cold water</td>
<td>Std. galvanized</td>
<td>Galv. 150 lb malleable iron screwed</td>
</tr>
<tr>
<td>Compressed air</td>
<td>Std. galvanized</td>
<td></td>
</tr>
<tr>
<td>(2 inch and larger)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressed air</td>
<td>Type AL@ seamless</td>
<td></td>
</tr>
<tr>
<td>(2 O.D. inch &amp; smaller)</td>
<td>hard-drawn copper tubing</td>
<td></td>
</tr>
<tr>
<td>Instrument piping shall be in accordance with ASA Standard B31.1-1955. Appendix I.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cast Iron
No cast iron materials shall be used on the HTW pressure systems.
PIPE CONSTRUCTION

Screwed Joints
Threaded pipe joints shall have American Standard taper pipe threads. Pipe ends shall be reamed to remove burrs after threading. Pipe joints should be assembled Teflon Tape or an approved compound applied to the male threads only. Not less than 3 threads must show outside of pipe fittings after joints are made up, except in the case of recessed heavy steel fittings. Normally threaded pipe will be installed for HTW piping in sizes 3/4 inch and smaller, and low pressure piping for sizes 2 inch and smaller, where specified.

Welding

Unless otherwise specified, all joints between sections of pipe and between pipe and fittings 2 inches and larger shall be electric arc welded and all joints shall be on pipe only, unless socket weld fittings are used. No fittings 1-1/2 inches and smaller shall be gas welded. The welding shall conform to American Standard Association Code B31.1, Supplement No. 1. All changes in direction of pipes shall be made with welded fittings for sizes 1 inch and larger except as otherwise specified. Mitering of pipe to form elbows, notching straight runs to form tees, or any similar construction will not be permitted. Branch connections made at a 45° angle from supply and return pipes shall be fabricated. All welds shall be stamped with welder’s initials.

QUALIFICATION OF PIPE WELDERS

Before assigning any welder to work covered by this specification, the Contractor shall provide the Owner with the names of pipe welders to be employed in the work, together with certification that each of these welders has passed qualification tests as prescribed by the National Certified Pipe Welding Bureau, or by other reputable testing laboratory, using procedures covered in American Society of Mechanical Engineers Boiler Construction Code, Section IX, or in American Welding Society Standard B3.0. If requested by the Owner, the Contractor shall submit identifying stenciled test coupons made by any welder in question. The Contractor shall require any welder to retake the tests when, in the opinion of the Owner, the work of the welder creates a reasonable doubt as to his proficiency. Tests, when required, shall be conducted at no additional expense to the Owner. Re-certification of the welder shall be made to the Owner only after the welder has taken and passed the required retest.

PROVISION FOR EXPANSION

Normally, all HTW pipe expansion shall be accomplished by pipe deflection in offsets, bends or loops. Pipes shall be cold sprung for one-half the designed expansion. Maximum allowable stress shall not exceed 22,000 psi.
PIPE HANGERS AND SUPPORTS

Pipe Supports

All necessary structural members, hangers and supports of approved design shall be provided to keep piping in proper alignment and to prevent transmission of injurious thrusts and vibrations. Pipe hangers shall be of the clevis pipe clamp type with suspension bolts for pipes 2 inches and larger shall use roller type supports. All bolts shall have provision for vertical adjustment and be equipped with locknuts. Hangers supported from upper floor steel shall be approved wrought steel beam clamps. Where concrete inserts are used, they shall be suitably reinforced. Expansion shields may be used provided the hanger is not attached rigidly to the expansion bolt, but is supported from a suitable bracket held in place by expansion bolts. Spring and spring roller hangers shall be used wherever vertical movement of pipe occurs so that pipe and pipe hangers shall always be in absolute contact.

Support Spacing

The following is a schedule of maximum spacing for hangers or other supports and size of suspension rods:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Rod Diameter</th>
<th>Maximum Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/4 inch and smaller</td>
<td>2 inch</td>
<td>6 feet</td>
</tr>
<tr>
<td>1-1/2 inch and 2 inch</td>
<td>2 inch</td>
<td>9 feet</td>
</tr>
<tr>
<td>2-1/2 inches and 3 inches</td>
<td>5/8 inch</td>
<td>10 feet</td>
</tr>
<tr>
<td>4 inches and 6 inches</td>
<td>3/4 inch</td>
<td>10 feet</td>
</tr>
<tr>
<td>8 inches and 10 inches</td>
<td>7/8 inch</td>
<td>10 feet</td>
</tr>
<tr>
<td>12 inches and 14 inches</td>
<td>1 inch</td>
<td>10 feet</td>
</tr>
</tbody>
</table>

Insulation Protection

Insulation for pipes 2 inches and larger in diameter shall be protected from damage, where supported by roller hangers, by suitable pipe covering protection saddles. Saddle shall support pipe on roller and shall be packed with insulation.

Anchors

Anchors shall be located where indicated by the drawings and shall be applicable to the type of piping installed. In general, the anchor shall conform to the details on the drawings. All anchor bolts, after tightening, shall be welded to the anchor frame in such a manner that all anchor bolts are effective. Additional restraining pipe supports shall be provided wherever danger of excessive pipe movement exists.

Heavy Pattern Nuts

All hangers, supports, and anchors shall be assembled with heavy pattern, hexagon carbon steel nuts.

Pipe Sleeves

All pipes passing through masonry construction shall be fitted with sleeves. Each sleeve shall extend through its respective floor or wall and shall be cut flush with each surface unless otherwise required. Unless otherwise specified, sleeves shall be three inches larger in diameter than the passing pipe when uninsulated and one pipe size larger than the overall outside diameter of the pipe when insulated. Sleeves in outside wall shall be made of galvanized steel pipe with a water-stop flange.
SECTION 4 - VALVES

Valve Specifications

All valves in the high temperature water system 2 inches and larger shall be of the ASA 300 lb. class, cast steel body weld ends, outside screw and yoke pattern, stainless steel trim with bolted bonnet and gland (Crane, Jenkins, Powell or Newco). Valves 1 1/2 inch and smaller shall be steel, ASA 800 lb. class socket weld, outside screw and yoke type with welded bonnet (Velan, Vogt, Yarway, or Bonny Forge). Valve stuffing boxes shall be large and deep to accommodate a minimum of six packing rings for valves 2 inches and larger, and a minimum of four rings for valves 1-2 inches and smaller. The packing shall be Teflon impregnated for high temperature water service. A metal insert having proper stem clearance shall be provided at the bottom of the stuffing box to serve as a base for the packing. HTW valves shall have a gland flange with not less than 2 gland bolts; forged steel packing nuts are permissible in conjunction with socket weld valves. Valve stems shall have a beveled collar at the lower end, which shall seat the valve under pressure when fully open. Flanged valves where approved by the owner shall have a 1/16 inch raised face on the flange. Valves are subject to shop drawings procedures.

Weld Valves

All pipeline valves 6 inches and larger shall be gate valves with bypass valves, butt welded ends and flanged bonnets. Valves of 4 to 3/4 inch sizes shall be steel gate, globe, or angle valves with socket or weld ends and welded bonnet as specified.

Gate Valves

Gate valves shall be of the solid wedge type with stainless steel wedge or wedge faces, stainless steel seat rings, long, close-fitting stem guides with port opening full pipe diameter.

Globe Valves

Globe and angle valves shall be of the cast plug disc type with bevel seat and disc of stainless steel, long disc locknut, and with port opening full pipe diameter.

Check Valves

Horizontal check valves shall be of the swing type. Valves shall have stainless steel discs. Discs shall be replaceable without removing valve from the pipe and be tight seating and full pipe diameter.

Drain and Vent Valves

Drain valves shall be sized as shown on the drawings. Drain valves shall be socket welded or screwed globe or angle forged steel valves.

Small Valves

Vent valves shall be 800 lb. forged steel globe valves. Bypass valves shall be 800 lb. forged steel, plug seated globe valves designed for throttling service. Pressure gauge and instrument isolating valves shall be 1/2 inch 2,000 lb. hex stainless steel block and bleed type as manufactured by Vogt or Bonny Forge.

Valve Operators

Gate valves, 6 inch and larger, shall be lubricated gear operated.
SECTION 5 - TESTING, WASHING, AND FILLING PIPES

Tests for Piping

The high temperature water distribution piping system shall be tested hydrostatically before insulation is applied and shall be proved tight with a pressure of 525 Psig. Pipes with expansion joints shall not be tested with a pressure higher than 400 Psig. and shall only be tested in the presence of the supplier of the expansion joints. A log of all tests shall be kept and furnished to the Owner. All tests can be made sectionally, provided a final test of 400 Psig. is applied to the entire system. When required by the Owner’s representative, pipe, but not welds, shall be pounded with a 2 lb. hammer during the test period. Upon completion of the above tests and prior to acceptance of the installation, the Contractor shall subject the high temperature water distribution system to such operating tests as may be required by the Owner to demonstrate satisfactory functional and operating efficiency. Operating tests and all tests shall be conducted at such times as the Owner may direct. All instruments, equipment, facilities, and labor required to conduct the tests properly shall be provided by the Contractor at no additional cost to the Owner, and all fuel, water, and electricity required for the tests will be furnished by the Contractor. Piping which fails to meet the above specified tests shall be replaced and retested without cost to the Owner.

Washing of Pipes

After the completion of the high temperature water installation and after all pressure tests, the Contractor shall wash out the pipes as follows: A mixture of caustic soda and soda ash dissolved in Ziolute softened water shall be circulated through the pipes at a velocity of not less than .5 ft/sec. The chemicals shall be thoroughly dissolved before being introduced into the system water in the proportions of 1 lb. of soda ash and 1 lb. of caustic soda per 1,000 lbs. of water. The water shall be heated to 225 F. and circulated through the system at that temperature. This process shall be continued for not less than 16 hours, whereupon the entire system shall be drained and thoroughly washed with fresh water. The Central Heating Plant pumping and heating equipment cannot be used during the washing out period, and it will, therefore, be the responsibility of the Contractor to furnish auxiliary equipment for this purpose.

Filling of Pipes

The Central Heating Plant facilities and capacity shall be used for the final filling of new and drained piping to insure lines are filled with deionized, treated water. Careful coordination with Central Heating Plant personnel will be required.
SECTION 6 – INSULATION

Pipe Covering

Insulation Specification

The molded pipe insulation employed shall be incombustible, non-corrosive when wet, a non-conductor of electricity, and shall be of a type which will not adhere to the pipe when wet, thus permitting free expansion of the pipe. The pipe covering shall be capable of being thoroughly dried out without a change in physical or chemical properties and shall be equally unaffected by a pipe temperature of 450 °F. The insulation shall have a thermal conductivity not in excess of 0.45 Btu. per hour per square foot per inch thickness at a mean temperature of 325° F. Insulation having a thermal conductivity in excess of that specified above will not be acceptable. Insulation shall retain its original insulating value throughout its service life. Insulation shall have a sufficient structural strength and impact resistance to withstand normal conditions encountered in installation and shall be capable of being removed and reapplied repeatedly for inspection, repair, or moving of pipes without damage or loss of thermal efficiency. This specification excludes magnesia and fiberglass and includes hydrous calcium silicate.

Insulation Samples

Samples of all pipe covering shall be submitted to the Owner for approval before installation.

Insulation Thickness

Unless otherwise specified or noted, all high temperature water supply and return piping in the Central Heating Plant, tunnels, underground tile conduits, manholes, and equipment rooms shall be insulated with a molded type of pipe covering as before specified in Section 7, 1-a above. All pipe insulation joints and/or broken edges and holes in insulation shall be filled with plastic material to the specified thickness not less than the following:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Normal Insulation Thickness</th>
<th>Performance &quot;C&quot; Factor</th>
<th>Mean Temp. 325° F. &quot;R&quot; Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2” and under</td>
<td>1 inch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 inches</td>
<td>1-1/2 inches</td>
<td>.30</td>
<td>3.33</td>
</tr>
<tr>
<td>3 inches</td>
<td>1-1/2 inches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 inches</td>
<td>1-1/2 inches</td>
<td>.225</td>
<td>4.45</td>
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<tr>
<td>6 inches</td>
<td>2 inches</td>
<td>.18</td>
<td>5.55</td>
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<tr>
<td>8 inches</td>
<td>2 inches</td>
<td>.15</td>
<td>6.67</td>
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<tr>
<td>10 inches</td>
<td>2-1/2 inches</td>
<td></td>
<td></td>
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<tr>
<td>12 inches</td>
<td>3 inches</td>
<td></td>
<td></td>
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</tbody>
</table>

*NOTE: Exception: Piping buried underground in molded insulating concrete conduit.*
Flange Insulation

Pipe insulation shall be stopped short of all flanges and beveled off to permit removal of flange bolts. Flanges shall be insulated with removable covers equal to that of the insulation on the adjacent piping and covered with hard finish asbestos cement. Flange insulation shall be applied only after all bolts have been retightened and pipes have been heated.

Insulation Jacket

Insulation shall be finished with an 8-ounce canvas jacket pasted or sewed on in a neat manner, except that the canvas jacket shall be omitted in the underground tunnel piping and aluminum sheet applied. Pipe and fittings in manholes shall be covered with aluminum jacket. A PVC jacket is permitted only in areas approved by the owner.

Insulation Underground

Piping in concrete chambers provided at expansion loops and bends and piping in concrete trenches and tile conduits shall receive the required thickness of calcium silicate insulation securely wired with No. 14 bare copper wire loops every 8 inches and shall be covered with a 60 lb. roofing felt lapped 3 inches on ends. The roofing felt shall be securely held in place with copper straps (3/4 inch wide x .010 inch thick) or stainless steel bands not more than 18 inches apart.

Wet Insulation

Particular care shall be exercised to prevent pipe and equipment insulation from becoming wet before, during and after installation. Insulation that does become wet before, during and/or after installation shall be dried out to the complete satisfaction of the Owner. The Owner shall be notified in writing that the insulation has become wet, together with a description of the methods to be used for drying the insulation. Any failure to comply with this requirement may result in replacing all insulation that has been wet at the discretion of the Owner.

HEAT EXCHANGERS

Insulation Specifications

High temperature water heat exchanger shells and tanks shall be insulated with not less than 2 inches of calcium silicate insulation. The insulation shall be securely wired to the converter. The insulation shall be finished with hard finish cement, applied over a 1-inch galvanized wire mesh, in 2 separate coats, and troweled to a smooth finish. All insulation shall be finished with an 8-ounce canvas jacket pasted or sewed in place in a neat manner.

Head Insulation

The heat exchanger HTW heads shall be insulated as stated above for the tanks, except that the insulation shall be beveled at the tank and pipe flanges for maintenance purposes, and so that the head insulation may be removed repeatedly without excessive damage or loss of thermal efficiency.
Insulation Sealer

All equipment and piping insulation canvas shall be sized with a heavy application of Arobol or Sealfast sealer. No glue size shall be used.

Formed Insulating Conduit (to be used as an alternative to a tunnel only as approved by the owner)

The underground pipes, to the extent indicated on the drawings, shall be installed side by side in a conduit consisting of Gilsulate 500xras manufactured by American Thermal Products, Inc. (no substitutes).

Provision for Expansion

Expansion of pipes shall be provided for by loops and/or bends as shown on the drawings. Positive voids shall be provided at the offsets. This detail shall be provided as required by the manufacturer and approved by the owner before proceeding with the installation.

Backfilling

The conduit shall be carefully backfilled with selected and approved material by hand shovels on both sides and top to a thickness not less than 6 inches. The material shall contain no stones larger than 1 inch diameter and shall be hand, or hand machine compacted.

Protection Mat

The portions of conduit installed beneath roads and parking areas and extending to a distance of 6 inches on each side of the insulating conduit shall be protected with a 4-inch reinforced concrete mat as shown on the drawings.

Outside Walls

The insulating conduit shall pass through concrete walls with details as approved by the manufacturer and the owner.

Supervision

Underground conduits shall be installed under the direct and continuous supervision of the Manufacturer’s authorized representative. Particular care shall be taken to prevent the conduit insulation from becoming wet either before or during installation, and insulation which becomes wet from any cause shall be properly dried out before installing or shall be replaced at the discretion of the Owner. Any noncompliance with the Manufacturer’s recommendations shall be reported in writing to the Owner by the Manufacturer’s representative supervising the installation. At the completion of the underground installation, the Manufacturer’s representative shall deliver to the Owner a certificate stating that the underground installation has been made in accordance with the Manufacturer’s recommendations.
SECTION 7 - HTW CONVERSION ROOMS

Location

The high temperature water conversion room shall normally be constructed outside of, but adjacent to, the building to be served. The intent here is to avoid piping the HTW inside the building where an undiscovered leak would cause inestimable damage. There shall be external stairs with a door leading to the equipment room.

Construction

The conversion room shall be constructed of reinforced concrete and of ample size as shown on the drawings. Ventilation shall be provided either by gravity or forced as required by the conditions. The floor should be sloped to the sides of the room, and an adequate gutter shall be provided on three sides and sloped to a sump pit with drain or sump pump. The concrete shall have Anti-Hydro added and be waterproofed externally with cold tar pitch.

Facilities

The conversion room shall be well lighted and have two or more duplex electric convenience outlets of the 3-wire grounded type. A hose bib shall be installed on the city water piping.

Security

A door shall be installed to open outward with a spring-type doorknob and key lock from the outside only and keyed to match existing security key series.

Entrances

The HTW piping shall enter the conversion rooms from underground and be fitted with HTW Flow and HTW Return service entrance gate valves. There shall be a 3/4-inch plug-seated globe-type bypass valve installed between the HTW Flow and HTW Return pipes inside of the service entrance valves and conversion room. The HTW pipes shall be suitable, anchored at the entrance to the conversion rooms by such methods that the expansion of the distribution system does not affect the conversion room piping.

Accessibility

All valves shall be installed with the stems horizontal or above, and shall be regulated, packed and glands adjusted at the completion of the work before final acceptance. All piping shall be erected to ensure proper draining and all valves and specialties arranged to permit easy operation and access.

Pipe Sizing

High temperature water supply and return pipes shall be sized so that the total head loss between the branch take-off at the supply and the equipment room effluent, including all valves and equipment, does not exceed 10 Psi. when operating at design capacity and the water velocity does not exceed 5 ft/sec.
Isolating Valves

Each heat exchanger shall have gate type isolating valves on both high temperature water connections to the coil. The automatic control valve shall be installed in the high temperature water return pipe from the heat exchanger and fitted with a correctly sized plug-seated globe valve bypass.

Equipment Supports

Pumps, air compressors, and all similar equipment shall be mounted on 4-inch high concrete bases.

Drains and Overflows

Piping, 4 inch and smaller from drains, vents and overflows shall be installed using standard weight, galvanized steel piping with standard weight galvanized malleable fittings, free from fins and burrs, with standard pipe threads. Drains and overflows shall be terminated over floor gutter adjacent to equipment. Furnish drains from all pump bases to floor gutter. All HTW drains shall be high pressure piping.

Air Removal

Air separation chambers shall be installed at all high points in the high temperature water piping as shown on the drawings. Air chambers shall be fabricated with a 12-inch nipple and weld cap one-half the diameter of the attached pipe, but in no case less than 3-inch diameter. A 2-inch globe type purge valve and vent pipe shall be installed for venting and be amply supported and shall discharge over floor drains or gutter.

Strainers

Strainers shall be installed upstream of all high temperature water control valves as shown on the drawings. Strainers shall be basket or Y type and have a cast steel body and be designed for 400 Psig. and 400° F. steam service. Strainers shall contain a stainless steel cylindrical strainer sleeve, having 3/32-inch perforations. The total area of free openings in the removable insert shall have a minimum of 3.30 times the cross sectional area of the pipeline in which it is installed. A blow down valve is not required.

Thermometers

An indicating thermometer shall be installed in the conversion room for high temperature water flow temperature as shown on the drawings. Also, an indicating thermometer shall be installed on the high temperature water effluent from all heat exchangers.

Pressure Gauges

Pressure gauges shall be installed on the high temperature water supply and return piping in all conversion rooms and be wall mounted with block and bleed isolating valves.
Equipment Arrangement

Heat exchangers and other equipment, together with their connecting piping, shall be arranged to facilitate operating and maintenance functions. Space allowance must be provided to enter manholes and for tube bundle removal. Maintenance areas and passageways shall be free from overhead and underfoot pipes and other obstructions. Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets and fittings and locations of all valves. The Owner reserves the right to make reasonable changes in the location of pipes, valves, etc. during progress of construction. All exchangers shall have a minimum of 3 feet clearance from walls and other equipment.

SECTION 8 - CONVERSION ROOM ACCESSORIES

Air Compressors

Air compressors of the motor driven, standard air-cooled piston type, complete with ASME storage tank, valves, gauges, filters, belt guards, and all necessary appurtenances for automatic pressure control shall be installed in conversion rooms to supply compressed air for operation of the pneumatic controls. Each compressor shall be a complete unit designed for 100 Psig. and sized to provide full operation of the control equipment based on the compressor not operating more than 25% of the time. Compressor shall operate at about 60 Psig. pressure. An outdoor air intake and intake filter shall be provided in a dry and accessible location.

Air Driers

A motor driven, refrigerated moisture condensing unit of full air compressor capacity, similar to Royce Model L-10F-1 or Hankinson Corp., Series E, shall be installed in the discharge of all instrument air compressors.

Panel board

Wall mounted panels shall be provided for the mounting of pressure gauges and controls. All heat exchanger controllers, compressed air supply pressure gauge, and high temperature water supply and return pressure gauges are to be mounted on panel board. The panels are to be factory fabricated, bonderized, and finished in light gray machinery enamel. All instruments are to be flush mounted and labeled for identification.

PRESSURE GAUGES

HTW Pressure Gauges

Pressure gauges for high temperature water systems shall be Ashcroft Duragages or U.S. Gauges with stainless steel tubes. Gauges shall be 4-1/2 inches or 6 inches in diameter as specified with a pressure range of 0-600 Psig., white face and black letters, a guaranteed accuracy of 1/2% of scale, 1/2 inch connection, and fitted with syphon and a 1/2-inch, 2,000 lb. block and bleed isolating valve.

Steam Pressure Gauges

Pressure gauges for high temperature water steam generators shall be compound gauges, 4-1/2 inches in diameter with a pressure range of twice the operating pressure, syphon and a 2-inch isolating lever handle cock, and meet HTW Pressure Gauge specifications as detailed above.

LP Pressure Gauges
Pressure gauges shall be liquid filled 4-inch diameter 0-160 psi, or as needed as stated on the drawings.

**THERMOMETERS**

**HTW Thermometers**

Indicating thermometers for high temperature water equipment shall be of the industrial mercury filled, glass bulb, red-reading type with a nine-inch (9") scale, five degree (5°) graduations, and a temperature range of 100 degree to 550 degree F. The thermometers shall have dustproof brass cases with chrome trim, bold face black numerals upon a white non-glare background. Thermometers shall be fitted with a 3/4-inch stainless steel separable socket and a 3-inch extension neck for insulation. Cases shall be installed either straight, angle, reclining, inclining, or right or left angle turn with respect to the stem, depending upon the application. The contractor shall select the proper stem orientation necessary to render the thermometer easily readable from the operating position. Thermometers shall be manufactured by Weiss or Palmer (no exceptions).

**Water Thermometers**

Indicating thermometers for low-pressure applications shall be Weiss or Weksler digital with 2” extension brass or s/s wells.

**Sump Pumps**

Vertical sump pumps for surface drainage shall be heavy-duty self-contained submersible pump units with a 1/2 HP, 115/230 Volt, single phase 60 cycle, totally enclosed motor. The pump shall be complete with a liquid level control totally enclosed automatic starting switch. The pump casing and impeller shall be bronze. The pump intake shall be provided with a heavy pattern brass strainer. The pump shall be capable of handling 30 gpm. at a total head of 30 feet. Specify Fairbanks Morse Model CD558 or Aurora for hot water service.

**Low Pressure Valves**

All low pressure valves 1-1/2 inches and smaller for installation on applications of steam, water, and compressed air, including gate, globe, ball, angle and check valves shall be bronze body with stainless steel trim and rated for not less than 200 Psig. for steam.

**BTU Meters** (See Division 15)
SECTION 10 – HTW STEAM GENERATORS

Specifications

Steam generators shall be constructed in accordance with the ASME Code for Unfired Pressure Vessels and TEMA Class C., and shall bear approval stampings required by these Codes complete with Insurance Inspection Certificate and be registered with the National Board and shall bear National board number. The steam generators shall have the capacity to generate steam of the required pressure as indicated on the drawings or specifications when supplied with 360°F high temperature water. The over-all dimensions of steam generators shall conform to the dimensions shown on the drawings and volume of the shell of the steam generator. The minimum heating surface shall be determined by the Architect/Engineer and include a "fouling factor" of .002 on the steam side, but no "fouling factor" need be considered on the high temperature water side. HTW head shall be bonnet type of fabricated steel with confined gasket joint. Joint needs a 3/16" recess in both head and throat. Gasket for joint to be Garlock 1/8\" (Faun) Gylon. The rate of steam generation and the maximum allowable quantity of high temperature water flowing through the tube bundles shall conform to the requirements set forth in the design analysis. The HTW steam generators shall be manufactured by Howard’s or Repco Engineering, Inc., Montebello, California; Patterson-Kelly Co., East Shroudsberg, Penn., or Thermexchanger, Inc., San Francisco, California.

Shop Drawings

Outline drawing and specification sheets shall be submitted to both the Architect/Engineer and Owner for approval in accordance with Section 7 of the General Conditions of the Contract, showing details of design, construction and materials, and a brief design analysis and computation for the amount of tube heating surface in sq. ft. offered.

Shell

Shells shall be constructed for an operating pressure of 150 Psig. and shall be subjected to a hydrostatic test pressure of 225 Psig. Shells shall be weldment fabricated from carbon steel plates and meet the applicable requirements of the ASME Code and National Board of Boiler Inspectors. HTW heads shall be bonnet type of cast or fabricated steel with confined gasket joint. Tube sheets shall be attached to steel with 4-shouldered bolts or similar construction so the HTW heads can be removed without disturbing gasket between the tube sheet and shell. A steam separator of an approved type shall be built in at the top of each steam generator. Interior of shell shall be painted with tow coats of "Apexior" No. 1 at the factory.

Supports and Mountings

Steam generators shall be mounted on a pipe stand or structural steel frames. Suitable steel saddles shall be provided for each generator. Shells shall pitch toward blowdown.

Tubes

Tube bundles shall be the U-tube type with bends stress relieved, designed to provide for expansion and contraction, and arranged for easy removal through a flanged shell opening for cleaning and inspection. All tube shall be designed for an operating pressure of 400 Psig. and 400°F water temperature and shall be subjected to a hydrostatic test pressure of 600 Psig. Pressure drop through tubes shall not exceed 8 feet, and velocity shall not exceed 7 feet per second. Tubes shall be positioned by square pitch in flange quality steel tube sheet and not less than 1/4 inch cleaning lane between tubes. Tubes shall be 5/8 inch or O. D., seamless, and constructed of the following material: No. 18 BWG Copper-Nickel (90% copper, 10% nickel). Tube bundle shall not normally exceed 8 feet length over all.
Steam Generator Piping Connections to be provided

1. High temperature water flow connection to coil - 300 lb. ASA flanged.
2. High temperature water return connection to coil - 300 lb. ASA flanged.
3. 2 inch drain from HTW head - coupling.
4. Steam outlet nozzle - 150 lb. ASA flanged.
5. Feedwater inlet - coupling.
6. 1 inch blowdown - installed on the bottom at manhole end - coupling.
7. 2 inch pressure gauge connection - coupling.
8. Safety valve connection - 150 lb. ASA flanged for sized 2-1/2 inches and larger.
9. 12 x 16 inch manhole.
10. 2 inch vent connection - coupling.
11. 2 inch pressure controller connection - coupling.
12. 1 inch equalizer connections to combination water gauge and feedwater controller (3) - couplings.
13. 2 inch continuous blowdown connection - coupling.
14. Others that may be shown on the drawings.

All pipe coupling outlets shall be 3,000 lb. and all nipples and nozzles shall be Schedule 80 pipe.

HTW connections shall clear head flanges.

STEAM GENERATOR ACCESSORIES

Level Controller

Feedwater controller, mounted on the steam generator shall be Magnetrol W-126, complete with gauge glass and drain connections. Two electrical liquid level contacts shall be provided.

Safety Valves

Drum safety valves shall be constructed and labeled in accordance with the ASME Code for Unfired Pressure Vessels. Relief capacity, not less than the steam generator rating, shall be stamped on the valve. Valve shall be set to pop at 10 Psig. above the operation pressure noted on drawings. Valve discharge shall be piped to outdoors in a safe area with full-sized escape pipe. Minimum size shall be 2 inches.

Boiler Blowdown

Blowoff valve shall be sized 1-inch and shall be the sliding plunger type, seatless, screwed, especially designed for this type of service, and designed for 250 lbs. maximum working pressure. (Yarway Type B.)

Boiler Blow-off Tank

There shall be a vented blowdown tank furnished and installed in locations where shown on the drawings. Blowdown tanks may be constructed of 16-inch diameter steel pipe (3/8 inch wall), by 48 inches long or a Wilson Series 83 centrifugal blowdown separator may be used. Tanks shall be provided with the following connections located as shown on the drawings:

1 inch diameter inlet - in head near top of tank.
2 inch diameter vent - in top of tank.
2 inch diameter overflow - with internal syphon.
1 inch diameter drain - in head at bottom of tank.
Pressure Gauge

Pressure gauge shall be 4-1/2 inch diameter compound gauge and calibrated for twice the designed working steam pressure. See HTW Spec., Section 9, 4-a.

Pressure Controller

Pressure controllers for high temperature water steam generators shall be Staefa digital/pneumatic. Pressure controllers shall be actuated by a pressure Transducer. This element is to be connected by pipe of tubing to the steam space of the generator. The air output from the pressure controller shall actuate a valve positioned directly connected to a pneumatic control valve in the high temperature water return piping. The controller shall be Staefa.

HTW Control Valves

Automatic control valves shall be single-seated, tight closing and shall have steel bodies with stainless steel trim. They shall be screwed for sized ¾ inch and smaller and flanged for 1 inch and larger. Valves shall be equipped with lubricating type stuffing boxes and shall have packing suitable for 400 deg. F. water service. Valve discs shall be top and bottom guided. Valves shall be V-ported "equal percentage" type – 50% stem travel in valve opening shall result in 20% maximum flow. Control valves and control instruments shall be reverse acting, designed to close on control air failure. Where two control valves are installed in parallel on one steam generator, they shall be split control, one valve to operate 3-10 lbs. And the other valve from 8-15 lbs. Air pressure. The valves shall be so constructed that either valve may be set in the field for either phase. Each instrument shall have its own drip well and supply air regulator. Valves shall be Valtek, Inc. Control valve manufacturer shall size the valve from information supplied by the Engineer.

FEEDWATER PUMP AND CONDENSATE RECEIVER

Feedwater Pump: A feedwater pump shall be installed for each steam generator unit. The pumps shall be duplicated if specified. The feedwater pumps shall have a 30% capacity margin greater than the capability of the steam generator it serves, against the predetermined head. Pumps shall be driven by drip-proof, ball-bearing motors and shall be controlled by a Magnetrol float switch on the steam generator. Pumps shall be single suction, closed impeller, close coupled, centrifugal type and set on pump drip bases installed on a 4-inch high concrete pedestal (Chicago Pump Co.).

Condensate Receiver

The condensate receiver shall be a low-pressure steel tank designed for either horizontal or vertical mounting. The receiver shall be mounted so as to produce 3 feet minimum positive suction head on the feed-water pump(s). It shall have sufficient storage capacity to supply the steam generator it served for 30 minutes. The condensate receiver shall be fitted with an automatic make-up water valve positioned to function only to prevent the feed-water pump from operating dry, and shall have outdoor vent, chemical feed, overflow, drain, and gauge glass. The make-up water valve shall be external float type with a strainer, pressure reducing valve, pressure gauge, 2 inch bypass valve, and isolating valves and unions. Some installations will require a deaerating feed-water heater and shall guarantee .03 cc/liter oxygen removal. (Schuab Eng. Co. or Owner approved equal).

Continuous Blowdown

HTW steam generators shall have a factory installed, internal continuous blowdown arrangement for applications requiring operation above 15 Psig. where substantial make-up water is required.
SECTION 11 - DOMESTIC HOT WATER GENERATORS

Specifications

Domestic and culinary hot water generators shall be double wall titanium tube constructed and labeled in accordance with the ASME Code and the TEMA Class C Code for Unfired Pressure Vessels, and shall be registered with the National Board and shall bear the National Board Number. The shell shall be of steel and built for an operating pressure of 150 Psig. and tested at a pressure of 225 lbs. The minimum heating surface shall be determined by the Architect/engineer and shall include a "fouling factor" of .005 on the low temperature water side. The high temperature water shall be 360 degrees F. at the inlet with a terminal temperature difference not exceeding 50 degrees F. at the maximum capacity. HTW flow pattern shall be either 2 or 4 pass. High temperature water shall flow inside the tubes, and water to be heated shall be in the shell. HTW head shall be bonnet type of fabricated steel with confined gasket joint. Joint needs a 3/16" recess in both head and throat. Gasket for joint to be Garlock 1/8" (Fawn) Gylon. Tube sheets shall be attached to the shells, so that HTW heads can be removed without disturbing gasket between tube sheet and shell. The shell shall receive a Phenolic 3-coat lining applied at the factor, suitable for the conditions specified. Hot water generators shall be the product of one manufacturer. Domestic and culinary hot water generators shall be manufactured by Howard’s or Repco Engineering, Inc., Montebello, CA; Patterson-Kelly Co., East Shroudsberg, PA; or Thermexchanger, San Francisco, CA.

Shop Drawings

Outline drawings and specification sheets shall be submitted to both the Architect and Owner for approval in accordance with section 7 of the General conditions of the Contract, showing details of design, construction and materials, and a brief design analysis and computation for the amount of tube heating surface in sq. ft. offered.

Converter Tubes

Tubes shall be U-tube type with bends stress relieved, designed to provide for expansion and contraction, and arranged for easy removal through a flanged shell opening for cleaning and inspection. Tubes shall be designed for operation at 400 Psig. Tube sheets shall be of flange quality steel and drilled for 1 inch square pitch for 5/8 inch tubes to provide for automatic scale shedding and mechanical cleaning. Pressure drop through the tubes shall not exceed 8 ft. and velocity shall not exceed 7 ft./sec. Tubes shall be 5/8 inch, seamless, and constructed of double wall titanium. Tube bundles shall not normally exceed 8 feet in length overall.

Generator Piping Connections to be Provided

1. High temperature water flow connection to coil - 300 lb. ASA flanged.
2. High temperature water return connection to coil - 300 lb. ASA flanged.
3. 2" drain on HTW head - coupling.
4. 12" by 16" manhole - below center line in rear head.
5. Cold water inlet - 150 lb. ASA flanged for sizes 2" and larger.
6. Hot water outlet for plumbing fixtures - 150 lb. ASA flanged for sizes 2" and larger.
7. 1" or larger drain on the storage tank - coupling.
8. 2" vent - coupling.
9. Relief valve connection (2 as required) - coupling.
10. 3/4 inch thermometer coupling in top of storage tank - coupling.
11. 1 inch coupling for thermostatic bulb, located in rear head above manhole flange.
12. 2 inch pressure gauge connection - coupling.
13. Others that may be shown on the drawings.
All pipe coupling outlets shall be 3,000 lb. and all nipples shall be Schedule 80 pipe.

Flanged HTW connections shall clear tube sheet upon removal.

**CONVERTER ACCESSORIES**

**Supports**

Suitable saddles for mounting storage tank.

**Drain**

1 inch or larger gate valve.

**Relief Valve**

Combined temperature-pressure relief valve shall be fully automatic, all bronze and ASME tested and rated. The valve or valves shall be Watts Regulator Co., Type 40XL, minimum size 3/4 inch and rated at minimum 77,600 Btu/Hr. each. One or two valves shall be installed as required to relieve the heat output of the converter coil. Valve shall be stamped to operate at 210° F. and 125 Psig or other as a specific building design may require. Provide full size escape pipe with visible outlet to nearest floor drain. Provide one 2” additional relief valve set at 150 Psig (Watts No. 174 A) in the event of a broken or sheared tube.

**Thermometer**

One Mercury filled thermometer, with 7-inch scale, and 6 inch immersion, graduated 30° F. to 300° F., separable socket connection, and extension neck for 2 inch insulation (see HTW Spec., Sec. 8, Pressure Gauges).

**Recirculating Pump**

Furnish and install hot water recirculating pumps of sizes and types as specified. (Bell and Gossett)

**Temperature Controller**

Temperature controllers for the domestic hot water heat exchangers shall be designed for automatic temperature regulation in the range of 100 to 200° F. The controller should be Staefa digital/pneumatic with stainless steel well for sensor and include a high temperature limit. Controls shall be panel mounted.

**HTW Control Valve**

Automatic control valves shall be single seated, tight closing, and shall have steel bodies with stainless steel trim. They shall be screwed for sizes 3/4 inch and smaller and flanged for 1 inch and larger. Valves shall be equipped with lubricating type stuffing boxes and shall have packing suitable for 400 deg. F. water service. Valves shall be B-ported "equal percentage" type. Control valves (and control instruments) shall be reverse acting, designed to close on control-air failure. Valves shall be Valtek, Inc. The control valve manufacturer shall size the valve based on information supplied by the Engineer.
HTW Domestic Hot Water Generator Sizes

When domestic hot water generators exceed 6 million Btu/hr. capacity, consideration must be given to multiple units.

**SECTION 12 - HTW SPACE HEATING CONVERTERS**

**Specifications**

Hot water space heating converters shall be constructed and labeled in accordance with the ASME Code for Unfired Pressure Vessels and TEMA Class C and shall bear the approval stampings required by these Codes and be registered with the National Board and shall bear the National Board number. The shell shall be built for a operating pressure of 150 Psig. and tested with a test pressure of 225 lbs. The shell shall have a 12-inch extension on low temperature water outlet and for installation of temperature control bulb. The minimum heating surface shall be determined by the Architect/Engineer and shall include a "fouling factor" or .003 at the low temperature side. Not "fouling factor" shall be considered at the high temperature water side. The calculation shall assume a secondary system water temperature of 210°F., maximum at the outlet, at maximum load. The high temperature water shall to 360°F. at the inlet with a temperature terminal difference not exceeding 15°F. at the maximum capacity output. HTW flow pattern shall be either 2 or 4 pass. Pressure drop at maximum load on the shell side shall not exceed 8 feet. High temperature water shall flow inside the tubes and low temperature water shall be in the shell. HTW head shall be bonnet type of fabricated steel with confined gasket joint. Joint needs a 3/16" recess in both head & throat. Gasket for joint to be Garlock 1/8" (Fawn) Gylon. Tube sheets shall be attached to shell with 4 shouldered bolts or similar constructions so that HTW heads can be removed without disturbing gasket between tube sheet and shell. The secondary low temperature inlet is to be on the bottom in the front, and the discharge is to be on top at the back. The 3/4" fitting for thermal sensing is to be on the secondary discharge piping between heat exchanger and flange. Space heating converters shall be the product of one manufacturer. Space heating converters shall be manufactured by Howard’s or REPCO, Inc., Montebello, California, Patterson-Kelly Co., East Shroudsberg, Penns., or Thermexchanger, San Francisco, California.

**Shop Drawings**

Outline drawings and specification sheets shall be submitted to both the Architect and Owner for approval in accordance with section 7 of the General Conditions of the Contract, showing details of design, construction and materials, and a brief design analysis and computation for the amount of tube heating surface in sq. ft. offered.

**Converter Tubes**

Tubes shall be U-tube type with bends stress relieved, designed to provide for expansion and contraction, and arranged for easy removal through a flanged shell opening for cleaning and inspection. Tubes shall be designed for operation at 400°F. water temperature, and shall be subjected to hydrostatic test pressure of 600 Psig.

Tube sheets shall be of flange quality steel with 3/16" minimum ligament and square tube pitch for 5/8 tubes respectively. Pressure drop through the tubes shall not exceed 8 feet, and velocity shall not exceed 7 ft/sec. Tubes shall be 5/8 inch O.D., seamless, constructed of the following material: No. 18 BWG Copper-Nickel (90% copper, 10% nickel). Tube bundles shall not normally exceed 8 feet length overall.

**Converter Piping Connections shall be provided as follows**

1. High temperature water flow connection to coil - 300 lb. ASA flanged.
2. High temperature water return connection from coil - 300 lb. ASA flanged.
3. 2 inch drain on HTW head - coupling.
4. Hot water heating system flow - 150 lb. ASA flanged.
5. Hot water heating system return - 150 lb. ASA flanged.
6. 1 inch drain in tank - coupling.
7. 2 inch pressure gauge connection - coupling.
8. 2 inch vent - coupling.
9. 3/4 inch temperature controller connection between outlet flange and shell.
10. Pressure relief valve (2") - 150 lb. coupling.
11. Others that may be shown on the drawings.

All pipe coupling outlets shall be 3,000 lb. and all nipples shall be Schedule 80 pipe.
Flanged HTW connections shall clear tube sheet upon removal.

CONVERTER ACCESSORIES

Supports
Suitable saddles for mounting converter tank.

Drains
3/4 inch gate valve and hose bib adapter for drain.

Relief Valve
Converter shell relief valves shall be constructed and labeled in accordance with the ASME Code for Unfired Pressure Vessels. Relief capacity, not less than the converter rating, shall be stamped on the valve. Valve shall be spring-loaded and set at a pressure 50 lbs. above the normal working pressure of the secondary heating water system. Valve shall have a test lever with provision to prevent water leaking from valve casing. Provide full size escape pipe to nearest floor drain. Minimum size shall be 2 inch (Watts No. 174A), to relieve the capacity of a sheared or broken tube.

Thermometer
One Mercury-filled thermometer with 7-inch scale graduated 30°F., 6 inch immersion, separable socket connection, and extension neck for 2" insulation (see HTW Spec. Sec. 8, Thermometers).

Pressure Gauge
Pressure gauge, 4-1/2 inch diameter size, with pressure range of 0-160 lbs. with 2 inch bar-stock valve (see HTW Spec., Sec. 8, Pressure Gauges).

Temperature Controller
Temperature controllers for the high temperature water space heating converters shall be Staefa digital/pneumatic control. The air output from the temperature controller shall actuate a valve positioner directly connected to a pneumatic control valve in the high temperature water return piping. Each instrument shall have its own drip well and supply air regulator. The control shall contain an auxiliary panel with a selector switch provided with auto, manual, and test positions and related equipment. Controller shall contain a relay of interlock to close HTW control valve whenever low temperature water circulating pump(s)
is not operating. However, interlock shall nor interfere with test operation of HTW control valve from auxiliary panel. Temperature controllers shall be Staefa.

**HTW Control Valve**

Automatic control valves shall be single seated, tight closing and shall have steel bodies with stainless steel trim. They shall be screwed for sizes 3/4 inch and smaller and flanged for 1-inch and larger. Valves shall be equipped with lubricating type stuffing boxes and shall have packing suitable for 400°F water service. Valve discs shall be top and bottom guided. Valves shall be V-ported equal percentage type - 50% stem travel in valve opening shall result in 20% of maximum flow. Control valves (and control instruments) shall be reverse acting, designed to close on control-air failure. Each instrument shall have its own drip well and supply air regulator. Valves shall be Valtek, Inc. The control valve manufacturer shall size the valve based on information supplied by the Engineer.

**Secondary System**

The converter shall be piped and valved on the secondary water shell in such a manner that the converter can be isolated and drained for maintenance purposes without draining the secondary heating system. When two or more space heating converters are specified for a single installation, either or both of the converters shall be piped and valved so that either can be isolated while the other converter remains in operation.
SEE SECTION II, DIVISION 4

H.T.W. STEAM GENERATOR

SIDE VIEW

FRONT VIEW