

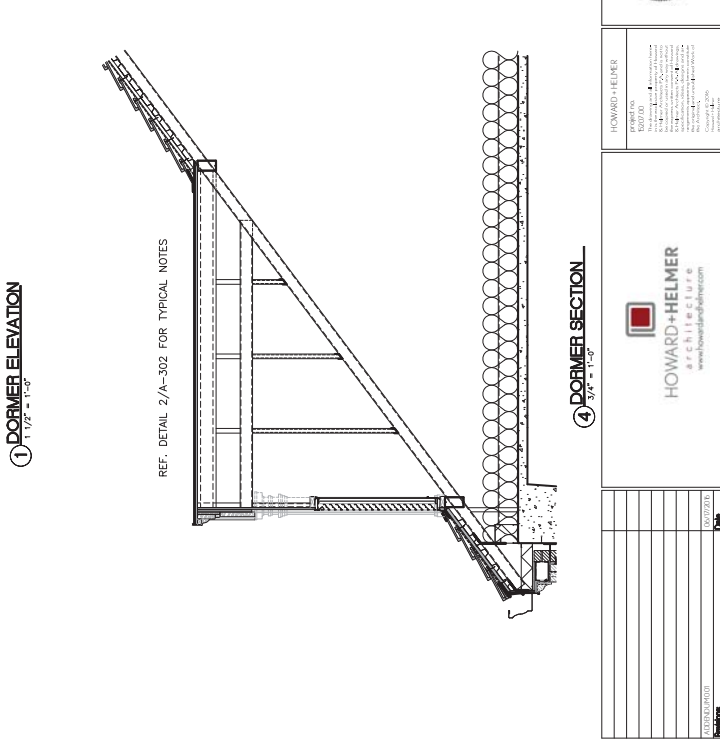
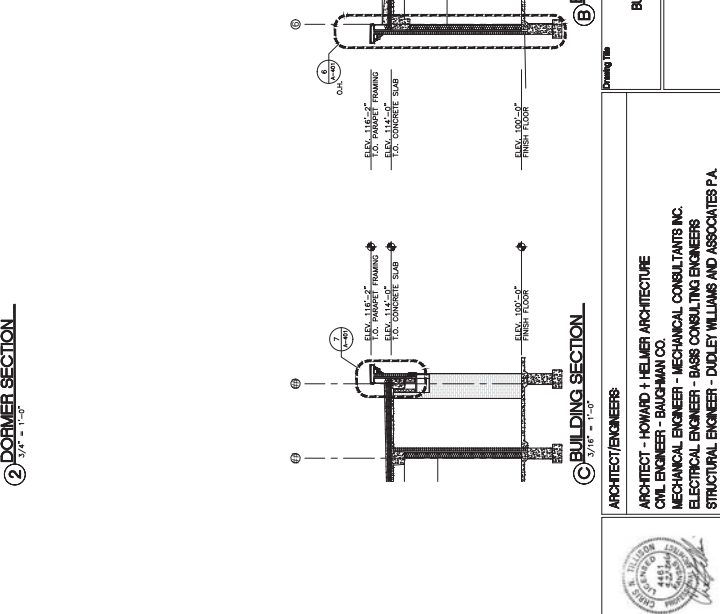
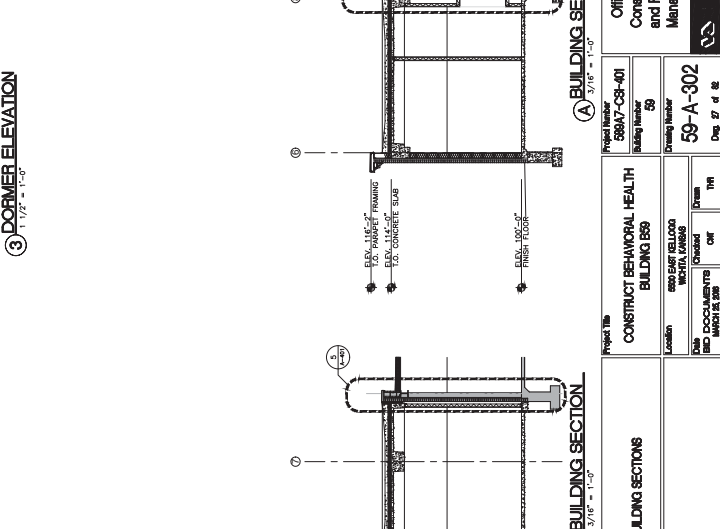
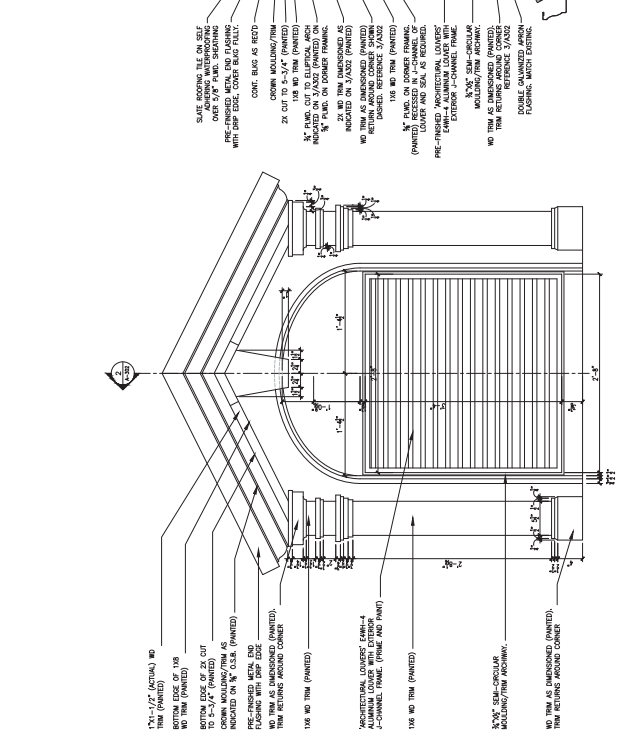
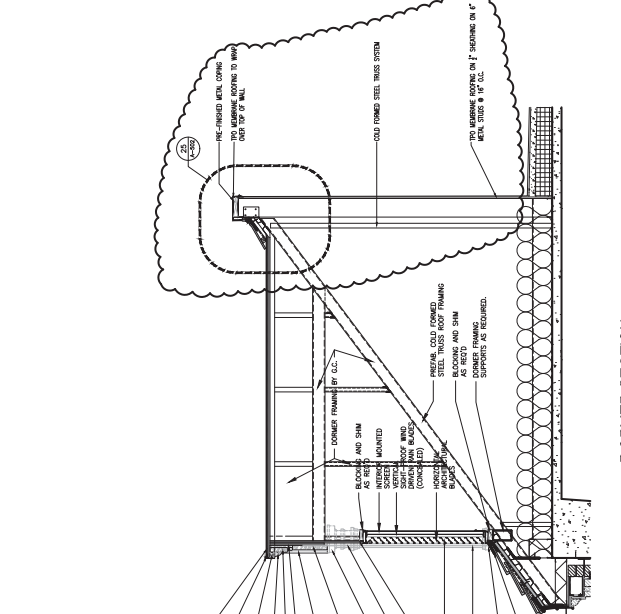
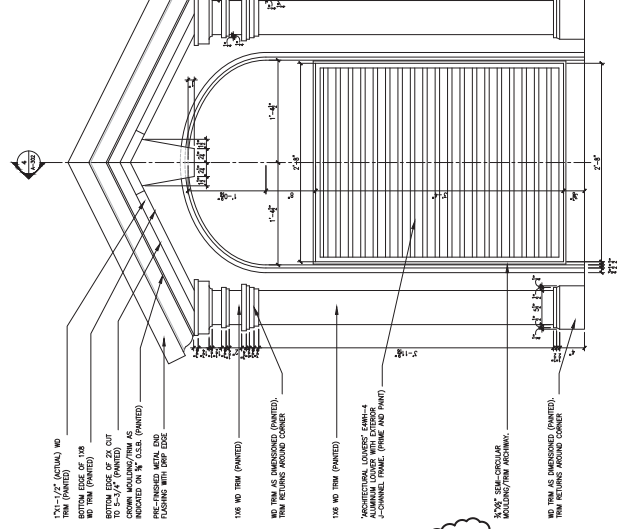


B BUILDING SECTION  
3/16" = 1'-0"

C BUILDING SECTION  
3/16" = 1'-0"

 HOWARD + HELMER architects www.howard-helmer.com		 HOWARD + HELMER PROJECT NO. 08-031 100% SCALE DRAWING DATE 06/22/08		ARCHITECT/ENGINEERS ARCHITECT - HOWARD + HELMER ARCHITECTURE CIVIL ENGINEER - GAUGHMAN CO. MECHANICAL ENGINEER - MECHANICAL CONSULTANTS INC. ELECTRICAL ENGINEER - BASS CONSULTING ENGINEERS STRUCTURAL ENGINEER - DUDLEY WILLIAMS AND ASSOCIATES P.A.		BUILDING SECTIONS		Project No. CONSTRUCT BEHAVIORAL HEALTH BUILDING 689		Project Number 59A7-C8-401 Building Number 59		Office of Construction and Facilities Management	
Location 580 EAST BELLOD WESTLAKE, OH 44190		Drawing Number 59-A-301		Drawing Title BUILDING SECTIONS		Project No. CONSTRUCT BEHAVIORAL HEALTH BUILDING 689		Project Number 59A7-C8-401 Building Number 59		Office of Construction and Facilities Management		Drawing Number 59-A-301	
Date 06/22/08		Drawing Title BUILDING SECTIONS		Project No. CONSTRUCT BEHAVIORAL HEALTH BUILDING 689		Project Number 59A7-C8-401 Building Number 59		Office of Construction and Facilities Management		Drawing Number 59-A-301		Drawing Title BUILDING SECTIONS	



REF. DETAIL 2/A-302 FOR TYPICAL NOTES

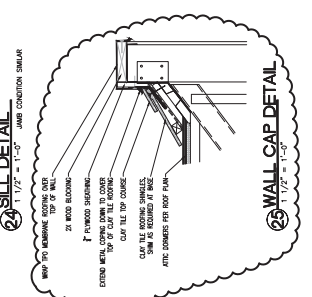
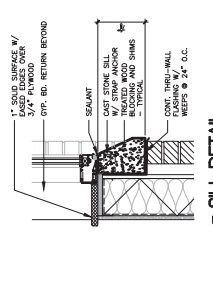
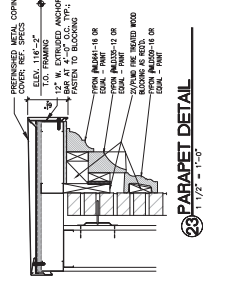
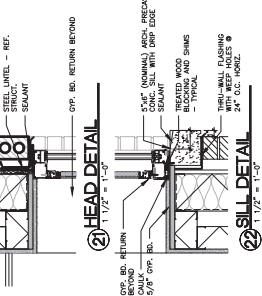
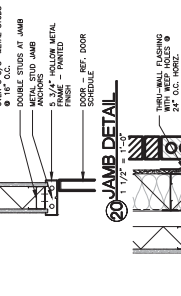
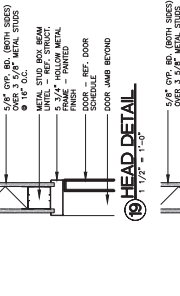
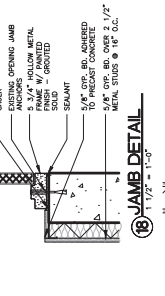
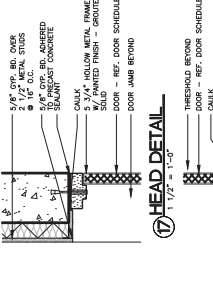
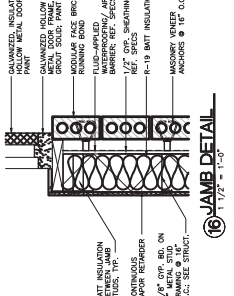
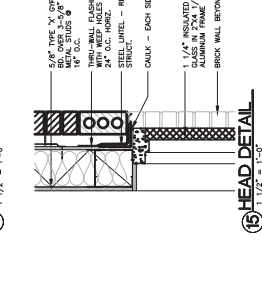
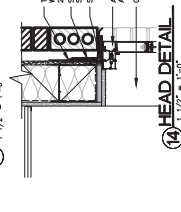
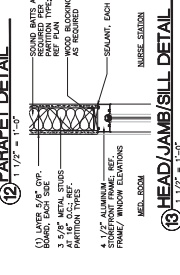
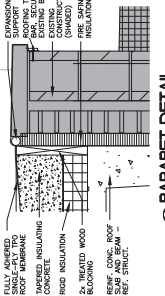
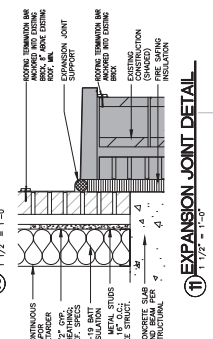
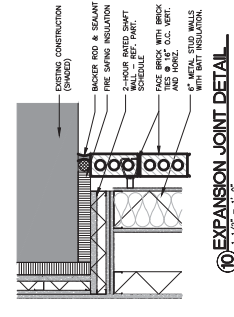
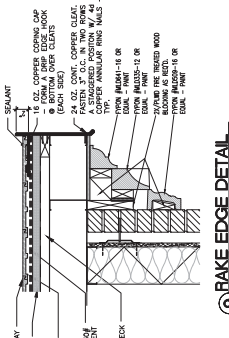
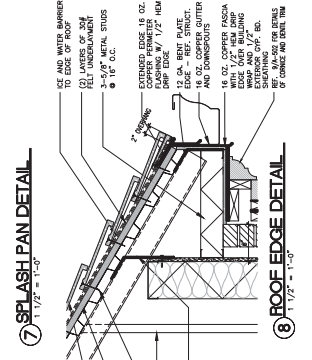
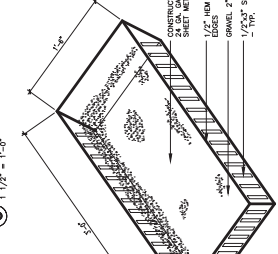
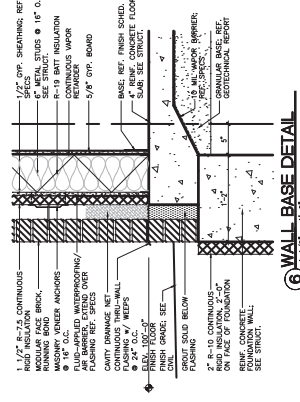
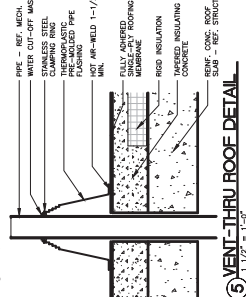
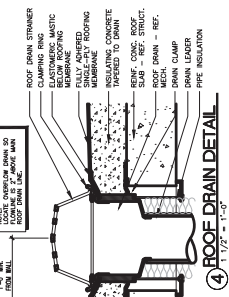
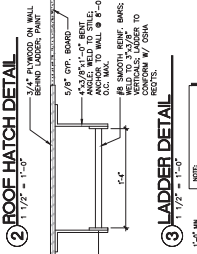
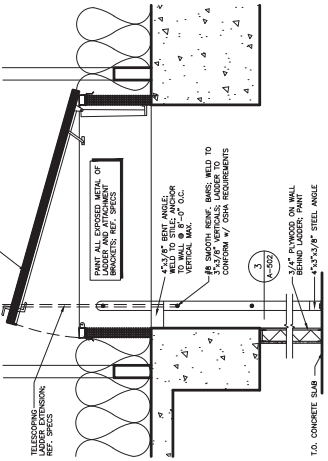
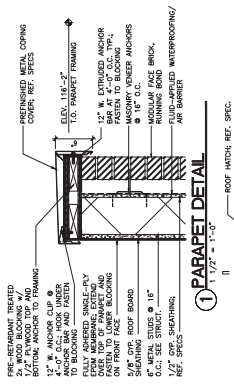
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1 1/2" x 1'-0"

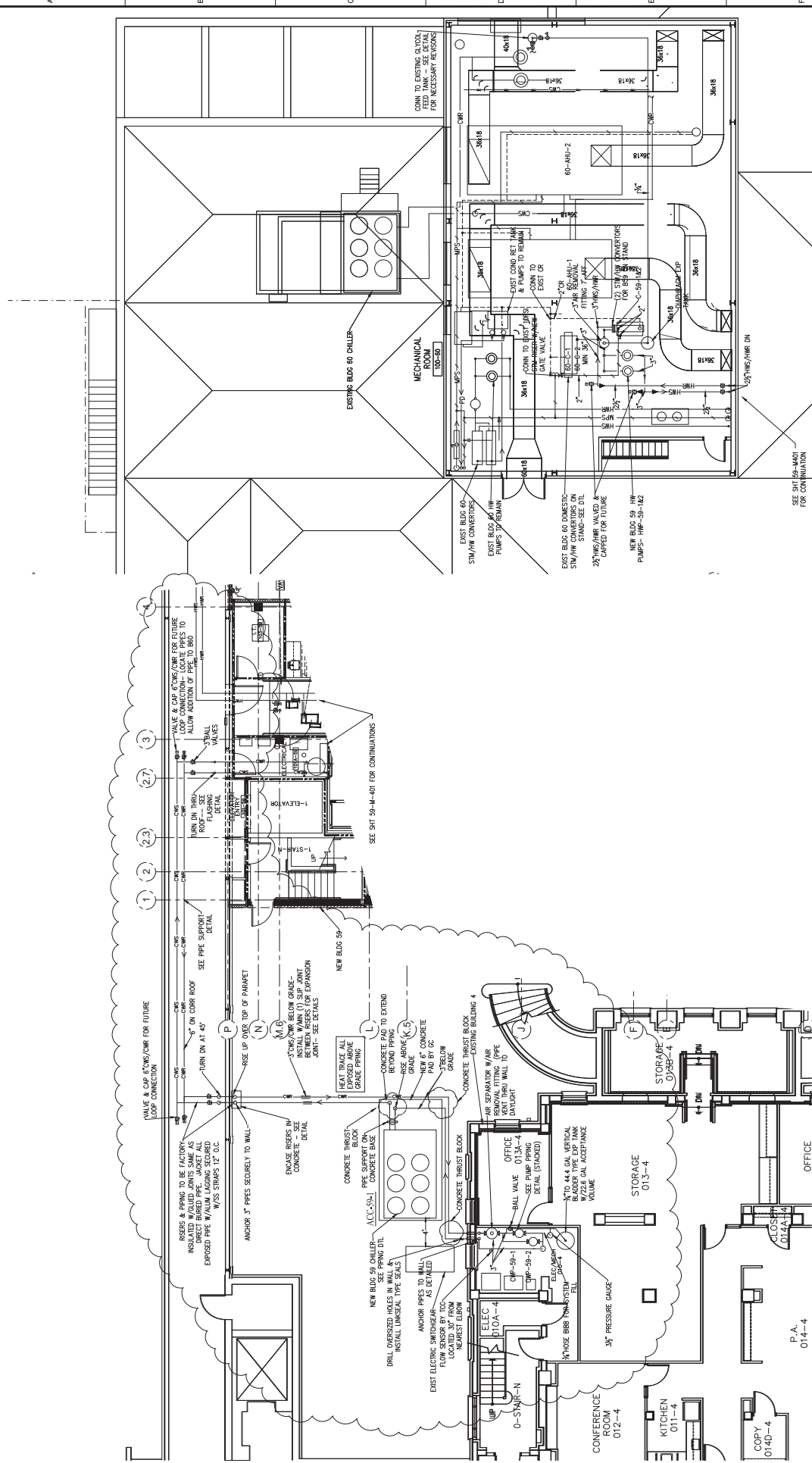
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② BUILDING SECTION  
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① BUILDING SECTION  
3/4" x 1'-0"

ARCHITECT/ENGINEERS		PROJECT No.		Office of Construction and Facilities Management	
ARCHITECT - HOWARD + HELMER ARCHITECTURE		CONSTRUCT BEHAVIORAL HEALTH BUILDING B69		59-A-302	
CHIL ENGINEER - GAGLIAN CO.		Location		59-A-302	
MECHANICAL ENGINEER - BASS CONSULTING ENGINEERS		Drawn		03/07/2016	
STRUCTURAL ENGINEER - DUDLEY WILLIAMS AND ASSOCIATES P.A.		Checked		03/07/2016	
PROJECT No.		59-A-302		03/07/2016	
ARCHITECT - HOWARD + HELMER ARCHITECTURE		CONSTRUCT BEHAVIORAL HEALTH BUILDING B69		59-A-302	
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PROJECT No.		59-A-302		03/07/2016	





**FIRST FLOOR BUILDING 4 HVAC PIPING PLAN**

SECOND FLOOR BUILDING 60 HVAC PIPING PLAN

[illegible]

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**SECTION 23 21 13**  
**HYDRONIC PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Water piping to connect HVAC equipment, including the following:
  - 1. Chilled water, heating hot water and drain piping.
  - 2. Glycol-water piping.
  - 3. Factory prefabricated (preinsulated) chilled water piping with bell ends and rubber gasketed joints for underground exterior service.
  - 4. Factory prefabricated (preinsulated) chilled water piping with glued joints for exterior above grade service.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- D. Section 23 07 11, HVAC AND BOILER PLANT INSULATION: Piping insulation.
- E. Section 23 25 00, HVAC WATER TREATMENT: Water treatment for open and closed systems.
- F. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Temperature and pressure sensors and valve operators.

**1.3 QUALITY ASSURANCE**

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, which includes welding qualifications.
- B. Design Working Pressure for Preinsulated Chilled Water Piping: 861 kPa (125 psig).
- C. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than one year old.
- D. Manufacturers Training Service: The Contractor shall obtain the services of an independent trained representative of the preinsulated chilled water pipe system manufacturer to instruct contractor's work force in installation procedures for all preinsulated, prefabricated systems.

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E. On Site Supervision of Underground Preinsulated Chilled Water Piping Installation:

1. Provide services of a factory trained representative of the pipe manufacturer for a minimum of three days, to include pre installation, installation and testing periods.
2. Representative's daily written reports to the COR: Present the original of each report on the day it is prepared and forward a copy to the manufacturer's main office. The report shall be signed by the manufacturer's representative. The report shall state whether or not the condition and quality of the materials used and the installation of the system is in accordance with the plans, specifications, and published standards of the manufacturer, and is satisfactory in all respects. If anything connected with the installation is unsatisfactory, the report shall state that corrective action has been taken or shall contain the manufacturer's recommendations for corrective action. The report shall cover any condition that could result in an unsatisfactory installation. The representative shall take prompt action to return to the factory all damaged and defective material, and shall order prompt replacement of such material.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
1. Pipe and equipment supports.
  2. Pipe and tubing, with specification, class or type, and schedule.
  3. Pipe fittings, including miscellaneous adapters and special fittings.
  4. Flanges, gaskets and bolting.
  5. Grooved joint couplings and fittings.
  6. Valves of all types.
  7. Strainers.
  8. Flexible connectors for water service.
  9. Pipe alignment guides.
  10. Expansion joints.
  11. Expansion compensators.
  12. All specified hydronic system components.



- ## 1.5 APPLICABLE PUBLICATIONS

- 23 21 13-3

B16.1-98.....	Cast Iron Pipe Flanges and Flanged Fittings
B16.3-2006.....	Malleable Iron Threaded Fittings: Class 150 and 300
B16.4-2006.....	Gray Iron Threaded Fittings: (Class 125 and 250)
B16.5-2003.....	Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard
B16.9-07.....	Factory Made Wrought Butt Welding Fittings
B16.11-05.....	Forged Fittings, Socket Welding and Threaded
B16.18-01.....	Cast Copper Alloy Solder Joint Pressure Fittings
B16.22-01.....	Wrought Copper and Bronze Solder Joint Pressure Fittings.
B16.24-06.....	Cast Copper Alloy Pipe Flanges and Flanged Fittings
B16.39-06.....	Malleable Iron Threaded Pipe Unions
B16.42-06.....	Ductile Iron Pipe Flanges and Flanged Fittings
B31.1-08.....	Power Piping

A47/A47M-99 (2004)	.....Ferritic Malleable Iron Castings
A53/A53M-07	.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A106/A106M-08	.....Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
A126-04	.....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
A183-03	..... Standard Specification for Carbon Steel Track Bolts and Nuts
A216/A216M-08	..... Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service
A234/A234M-07	..... Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service



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A307-07 .....	Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
A536-84 (2004) .....	Standard Specification for Ductile Iron Castings
A615/A615M-08 .....	Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
A653/A 653M-08 .....	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) By the Hot-Dip Process
B32-08 .....	Standard Specification for Solder Metal
B62-02 .....	Standard Specification for Composition Bronze or Ounce Metal Castings
B88-03 .....	Standard Specification for Seamless Copper Water Tube
B209-07 .....	Aluminum and Aluminum Alloy Sheet and Plate
C177-04 .....	Standard Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus
C478-09 .....	Precast Reinforced Concrete Manhole Sections
C533-07 .....	Calcium Silicate Block and Pipe Thermal Insulation
C552-07 .....	Cellular Glass Thermal Insulation
D3350-08 .....	Polyethylene Plastics Pipe and Fittings Materials
C591-08 .....	Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
D1784-08 .....	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compound
D1785-06 .....	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
D2241-05 .....	Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
F439-06 .....	Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

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- F441/F441M-02 ..... Standard Specification for Chlorinated Poly  
 (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules  
 40 and 80
- F477-08 ..... Elastomeric Seals Gaskets) for Joining Plastic  
 Pipe
- F. American Water Works Association (AWWA):
- C110-08.....Ductile Iron and Grey Iron Fittings for Water
- C203-02.....Coal Tar Protective Coatings and Linings for  
 Steel Water Pipe Lines Enamel and Tape Hot  
 Applied
- G. American Welding Society (AWS):
- B2.1-02.....Standard Welding Procedure Specification
- H. Copper Development Association, Inc. (CDA):
- CDA A4015-06.....Copper Tube Handbook
- I. Expansion Joint Manufacturer's Association, Inc. (EJMA):
- EMJA-2003.....Expansion Joint Manufacturer's Association  
 Standards, Ninth Edition
- J. Manufacturers Standardization Society (MSS) of the Valve and Fitting  
 Industry, Inc.:
- SP-67-02a.....Butterfly Valves
- SP-70-06.....Gray Iron Gate Valves, Flanged and Threaded  
 Ends
- SP-71-05.....Gray Iron Swing Check Valves, Flanged and  
 Threaded Ends
- SP-80-08.....Bronze Gate, Globe, Angle and Check Valves
- SP-85-02.....Cast Iron Globe and Angle Valves, Flanged and  
 Threaded Ends
- SP-110-96.....Ball Valves Threaded, Socket-Welding, Solder  
 Joint, Grooved and Flared Ends
- SP-125-00.....Gray Iron and Ductile Iron In-line, Spring  
 Loaded, Center-Guided Check Valves
- K. National Sanitation Foundation/American National Standards Institute,  
 Inc. (NSF/ANSI):
- 14-06.....Plastic Piping System Components and Related  
 Materials
- 50-2009a.....Equipment for Swimming Pools, Spas, Hot Tubs  
 and other Recreational Water Facilities -

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Evaluation criteria for materials, components,  
 products, equipment and systems for use at  
 recreational water facilities

61-2008.....Drinking Water System Components - Health  
 Effects

L. Tubular Exchanger Manufacturers Association: TEMA 9th Edition, 2007

## **1.6 SPARE PARTS**

A. For mechanical pressed sealed fittings provide tools required for each  
 pipe size used at the facility.

## **PART 2 - PRODUCTS**

### **2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES**

A. Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR  
 HVAC and STEAM GENERATION.

### **2.2 PIPE AND TUBING**

- A. Chilled Water, Heating Hot Water, and Glycol-Water and Vent Piping:
  - 1. Steel: ASTM A53 Grade B, seamless or ERW, Schedule 40.
  - 2. Copper water tube option: ASTM B88, Type K or L, hard drawn.
- B. Extension of Water Make-up Piping: ASTM B88, Type K or L, hard drawn  
 copper tubing.
- C. Cooling Coil Condensate Drain Piping:
  - 1. From air handling units: Copper water tube, ASTM B88, Type M, or  
 schedule 40 PVC plastic piping.
  - 2. From fan coil or other terminal units: Copper water tube, ASTM B88,  
 Type L for runouts and Type M for mains.
- D. Pipe supports, including insulation shields, for above ground piping:  
 Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- E. Chilled water piping underground and above ground outside of the  
 building walls: Factory prefabricated (preinsulated chilled water  
 piping.)

### **2.3 FITTINGS FOR STEEL PIPE**

- A. 50 mm (2 inches) and Smaller: Screwed or welded joints.
  - 1. Butt welding: ASME B16.9 with same wall thickness as connecting  
 piping.
  - 2. Forged steel, socket welding or threaded: ASME B16.11.
  - 3. Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron,  
 ASME B16.4, may be used in lieu of malleable iron. Bushing reduction  
 of a single pipe size, or use of close nipples, is not acceptable.

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4. Unions: ASME B16.39.
5. Water hose connection adapter: Brass, pipe thread to 20 mm (3/4 inch) garden hose thread, with hose cap nut.
- B. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints. Contractor's option: Grooved mechanical couplings and fittings are optional.
  1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
  2. Welding flanges and bolting: ASME B16.5:
    - a. Water service: Weld neck or slip-on, plain face, with 6 mm (1/8 inch) thick full face neoprene gasket suitable for 104 degrees C (220 degrees F).
    - 1) Contractor's option: Convuluted, cold formed 150 pound steel flanges, with teflon gaskets, may be used for water service.
    - b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gage connections.
- D. Grooved Mechanical Pipe Couplings and Fittings (SHALL NOT BE USED)

#### 2.4 FITTINGS FOR COPPER TUBING

- A. Joints:
  1. Solder Joints: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
  2. Mechanical press sealed fittings: **ARE NOT TO BE USED.**
  3. Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall insure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.
- B. Bronze Flanges and Flanged Fittings: ASME B16.24.

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- C. Fittings: ANSI/ASME B16.18 cast copper or ANSI/ASME B16.22 solder wrought copper.

## **2.5 FITTINGS FOR PLASTIC PIPING**

- A. Schedule 40, socket type for solvent welding.
- B. Schedule 40 PVC drain piping: Drainage pattern.
- C. Chemical feed piping for condenser water treatment: Chlorinated polyvinyl chloride (CPVC), Schedule 80, ASTM F439.

## **2.6 DIELECTRIC FITTINGS**

- A. Provide where copper tubing and ferrous metal pipe are joined dielectric nipples with black steel unions shall be used in lieu of dielectric unions.

## **2.7 SCREWED JOINTS**

- A. Pipe Thread: ANSI B1.20.
- B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

## **2.8 VALVES**

- A. Asbestos packing is not acceptable.
- B. All valves of the same type shall be products of a single manufacturer.
- C. Provide chain operators for valves 150 mm (6 inches) and larger when the centerline is located 2400 mm (8 feet) or more above the floor or operating platform.
- D. Shut-Off Valves
  1. Ball Valves (Pipe sizes 2" and smaller): MSS-SP 110, screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat at 2760 kPa (400 psig) working pressure rating. Provide stem extension to allow operation without interfering with pipe insulation.
  2. Butterfly Valves (Pipe Sizes 2-1/2" and larger): Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation. MSS-SP 67, flange lug type or grooved end rated 1205 kPa (175 psig) working pressure at 93 degrees C (200 degrees F). Valves shall be ANSI Leakage Class VI and rated for bubble tight shut-off to full valve pressure rating. Valve shall be rated for dead end service and bi-directional flow capability to full rated pressure. Not permitted for direct buried pipe applications.

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- a. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47 electro-plated, or ductile iron, ASTM A536, Grade 65-45-12 electro-plated.
  - b. Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable, if the stem is completely isolated from the product.
  - c. Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.
    - 1) Valves 150 mm (6 inches) and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.
    - 2) Valves 200 mm (8 inches) and larger: Enclosed worm gear with handwheel, and where required, chain-wheel operator.
    - 3) 3. Gate Valves (Contractor's Option in lieu of Ball or Butterfly Valves):
      - a) 50 mm (2 inches) and smaller: MSS-SP 80, Bronze, 1034 kPa (150 psig), wedge disc, rising stem, union bonnet.
      - b) 65 mm (2 1/2 inches) and larger: Flanged, outside screw and yoke. MSS-SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.
- E. NOT USED
- F. Check Valves
- 1. Swing Check Valves:
    - a. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.), 45 degree swing disc.
    - b. 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-71 for check valves.
  - 2. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.

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- a. Body: MSS-SP 125 cast iron, ASTM A126, Class B, or steel, ASTM A216, Class WCB, or ductile iron, ASTM 536, flanged, grooved, or wafer type.
  - b. Seat, disc and spring: 18-8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.
- G. Water Flow Balancing Valves: For flow regulation and shut-off. Valves shall be control valve size.
- 1. Ball or Globe style valve.
  - 2. A dual purpose flow balancing valve and adjustable flow meter, with bronze or cast iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure.

## **2.9 NOT USED**

## **2.10 STRAINERS**

- A. Y Type.
  - 1. Screens: Bronze, monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter perforations for 100 mm (4 inches) and larger: 3.2 mm (0.125 inch) diameter perforations.

## **2.11 FLEXIBLE CONNECTORS FOR WATER SERVICE**

- A. Flanged Spool Connector:
  - 1. Single arch or multiple arch type. Tube and cover shall be constructed of chlorobutyl elastomer with full faced integral flanges to provide a tight seal without gaskets. Connectors shall be internally reinforced with high strength synthetic fibers impregnated with rubber or synthetic compounds as recommended by connector manufacturer, and steel reinforcing rings.
  - 2. Working pressures and temperatures shall be as follows:
    - a. Connector sizes 50 mm to 100 mm (2 inches to 4 inches), 1137 kPa (165psig) at 121 degrees C (250 degrees F).
    - b. Connector sizes 125 mm to 300 mm (5 inches to 12 inches), 965 kPa (140 psig) at 121 degrees C (250 degrees F).
  - 3. Provide ductile iron retaining rings and control units.

## **2.12 HYDRONIC SYSTEM COMPONENTS**

- A. Tangential Air Separator: ASME Pressure Vessel Code construction for 861 kPa (125 psig) working pressure, flanged tangential inlet and outlet connection, internal perforated stainless steel air collector



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tube designed to direct released air into air purger, bottom blowdown connection. Provide with a removable stainless steel strainer element having 5 mm (3/16 inch) perforations and free area of not less than five times the cross-sectional area of connecting piping.

- B. Diaphragm Type Pre-Pressurized Expansion Tank: ASME Pressure Vessel Code construction for 861 kPa (125 psig) working pressure, welded steel shell, rust-proof coated, with a flexible elastomeric diaphragm suitable for a maximum operating temperature of 116 degrees C (240 degrees F). Provide Form No. U-1. Tank shall be equipped with system connection, drain connection, standard air fill valve and be factory pre-charged to a minimum of 83 kPa (12 psig).
- C. Pressure Relief Valve: Bronze or iron body and bronze or stainless steel trim, with testing lever. Comply with ASME Code for Pressure Vessels, Section 8, and bear ASME stamp.
- D. Automatic Air Vent Valves (where shown): Cast iron or semi-steel body, 1034 kPa (150 psig) working pressure, stainless steel float, valve, valve seat and mechanism, minimum 15 mm (1/2 inch) water connection and 6 mm (1/4 inch) air outlet. Pipe air outlet to drain.

### **2.13 WATER FILTERS AND POT CHEMICAL FEEDERS**

See section 23 25 00, HVAC WATER TREATMENT, Article 2.2, CHEMICAL TREATMENT FOR CLOSED LOOP SYSTEMS.

### **2.14 GAGES, PRESSURE AND COMPOUND**

- A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4-1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
- B. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gages in water service.
- C. Range of Gages: Provide range equal to at least 130 percent of normal operating range.
  - 1. For condenser water suction (compound): Minus 100 kPa (30 inches Hg) to plus 700 kPa (100 psig).

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## 2.15 PRESSURE/TEMPERATURE TEST PROVISIONS

- A. Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.

## 2.16 THERMOMETERS

- A. Mercury or organic liquid filled type, red or blue column, clear plastic window, with 150 mm (6 inch) brass stem, straight, fixed or adjustable angle as required for each in reading.
- B. Case: Chrome plated brass or aluminum with enamel finish.
- C. Scale: Not less than 225 mm (9 inches), range as described below, two degree graduations.
- D. Separable Socket (Well): Brass, extension neck type to clear pipe insulation.
- E. Scale ranges may be slightly greater than shown to meet manufacturer's standard. Required ranges in degrees C (F):

Chilled Water and Glycol-Water 0 to 38 degrees C (32-100 degrees F)	Hot Water and Glycol-Water -1 to 116 degrees C (30 to 240 degrees F).
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## 2.17 FIRESTOPPING MATERIAL

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

## 2.18 FACTORY PREFABRICATED (PREINSULATED) CHILLED WATER PIPING

- A. Inner Carrier Pipe: Polyvinylchloride (PVC) Pipe: PVC pipe shall conform to ASTM D 2241 with a Standard Thermoplastic Pipe Dimension Schedule 80 and PVC 1245A as the material. Pipe shall be extruded from clean, virgin approved class 12454A PVC compound conforming to ASTM D1784 and shall be joined by integral bell and spigot joints or fittings, using rubber ring gaskets, or if used above grade shall be joined with solvent weld type glue.
- B. Outer Casing: [The polyvinyl chloride (PVC) casing pipe shall be of virgin PVC resin meeting the minimum classification requirements of ASTM D1784, Class 12454-B and has a minimum thickness of 60 mils. This jacket in combination with the foam system is suitable for H-20 highway loading with two feet of cover providing that the pipe bedding and

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backfill material are properly placed and compacted to H-20 specifications. The 80 lb casing thickness shall be 0.20" thick for 6" diameter pipe.

C. Polyurethane Foam Insulation:

1. Polyurethane foam insulation shall meet the following specifications:

Type:	Two component urethane
Compressive Strength:	35 psi parallel min at 5% Comp
Shrinkage:	None at 70°F
Free Rise Density:	2.0 to 3.0 lbs/cubic foot
Aged "K" (70°F - 72 hrs)	0.140 BTU-in/hr-ft <sup>2</sup> -°F
Closed Cell Content:	90%

2. Nominal insulation thickness shall be as defined in the approved Federal Brochure as follows:

Carrier Pipe Size (in.)	Insulation Thickness (in.)
1.5	1.16
2	0.92
2.5	1.51
3	1.20
4	1.67
6	1.59
8	1.57

3. Insulation concentricity: Carrier pipe shall be concentric to casing pipe. The allowable maximum deviation from centerline of carrier pipe shall be plus or minus 1/4 inch at the casing center point and plus or minus 1/16 inch at the end seals.

D. Wall Penetration Sleeves: Provide wall penetration sleeves where piping passes through masonry or concrete walls. Sleeves in outside walls below and above grade shall be schedule 40 or standard weight coated black steel pipe or as specified by the Design Engineer. Sleeves shall be held securely in proper position and location during construction. Sleeves shall be of sufficient length to pass through entire thickness of walls or slabs. Refer to typical detail of wall penetration as shown. In existing concrete manholes or building walls, penetrations may be made using the "core drilling" method, providing proper care is

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taken to drill the holes to the size needed and square to the line of the pipe.

E. Wall Penetration Seals: All wall penetrations shall be sealed to prevent water from entering the building or manhole.

1. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

F. Field Applied Insulation:

1. Insulation for valves, fittings, field casing closures, if required, and other piping system accessories shall be cellular polyisocyanurate or polyurethane matching the pipe insulation. Insulation shall be premolded, precut or job fabricated to fit and shall be removable and reusable. Thickness shall match adjacent piping.

2. Aluminum Metal jackets shall be provided for all pipe insulation exposed above grade. Jacketing bands shall be 19 mm (3/4-inch) wide [0.13 mm (0.005-inch)] thick stainless steel or [0.02 mm (0.0007-inch) aluminum].

3. Buried fittings and accessories shall be factory fabricated and may have field foamed polyurethane insulation to match adjacent piping and shall be protected with a covering matching the pipe casing. Shrink sleeves shall be provided over casing connection joints.

G. End Seals:

1. General: Each preinsulated section of piping shall have a complete sealing of the insulation to provide permanent water and vapor seal at each end of the preinsulated section of piping. Preinsulated sections of piping modified in the field shall be provided with an end seal which is equivalent to the end seals furnished with the preinsulated section of piping. Provide complete sealing of the insulation at each end of each preinsulated conduit section by one of the following methods:

a. Carrying the outer casing over tapered pipe insulation ends and extending it to the carrier pipe. Provide sufficient surface bonding area between the casing and the carrier pipe to ensure a permanent water and vapor-resistant seal.

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- b. Using specially designed prefabricated caps made of the same material and not less than the same thickness as the casing. Provide sufficient surface bonding area between the cap, and both the casing and carrier pipe, to ensure permanent water and vapor-resistant seal.
  - c. Using rubber ring gaskets designed and dimensioned to fit in the annular space between the casing and carrier pipe in such a manner as to ensure a permanent water and vapor-resistant seal.
  - d. Using shrink sleeves that shall be either heat shrinkable high temperature rubber or polyethylene material that can be bound to the carrier pipes and casing to ensure a permanent water and vapor-resistant seal.
2. Factory casing and end seal testing and certification:
- a. Testing and certification procedures by an independent testing laboratory shall demonstrate that casings and end seals are capable of resisting penetration of water into the casing and insulation at 60 kPa (20 feet) of head pressure, measured above the highest point of the test sample, subjected over the entire surface of a 2.5 m (8-feet) test sample of prefabricated pipe for not less than 48 hours. Test shall use 24 degrees C (75 degree F) water for chilled water service, while the sample is either buried or encased in dry bedding sand with a minimum of 305 mm (12 inches) of sand all around sample. The carrier pipe size in the test section shall be 75 mm (3 inches) in diameter and shall be restrained during the test period. The insulation thickness shall not exceed the maximum thickness provided for the piping in the project.
  - b. Test results for Federal Agency Committee on Underground Heat Distribution System, or similar results may be substituted.

H. Couplings:

- 1. Insulated pipe couplings for copper tubing: Insulated pipe couplings for copper tubing shall be cast bronze containing an O-ring seal on each end and shall be jacketed and sealed to act as an expansion joint.
- 2. Bell and spigot joints: Rubber ring joining system. Bell and spigot joints may also be of the bonded type where the joint is made up

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utilizing a suitable adhesive for the service specified. Adhesive shall be furnished by the pipe manufacturer.

3. Mechanical couplings for steel pipe: Mechanical couplings for steel pipe shall be the sleeve type or the type for grooved end pipe and shall provide a tight, flexible joint under all conditions including movements caused by expansion, contraction, slight settling or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Coupling strength shall not be less than the connecting pipe sections. Sleeve-type couplings shall be used for joining plain end pipe sections. The sleeve couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets. Grooved end pipe couplings shall consist of identical coupling sections fastened in place, using track head bolts, ASTM A183, to confine a molded gasket over the pipe and gap. Couplings shall be malleable iron or ductile iron.

#### I. Joints:

1. Welded joints: Welded joints between sections of pipe and between pipe and fittings shall be provided where specified or indicated. Branch connections shall be made with either welding tees or forged branch outlet fittings attached to the main and reinforced against external strains.
2. Flanged joints: Flanged joints shall be provided with gaskets and made perfectly square and tight. Full-faced gaskets shall be used with cast-iron flanges and all gaskets shall be as thin as the finish of the flange face permits. Gaskets shall be 5 mm (3/16-inch) thick for 25 through 300 mm (1 through 12 inch) flanges and 6 mm (1/4-inch) thick for flanges 350 mm (14 inches) and larger.
3. Threaded joints: Joints shall be made tight with polytetrafluoroethylene tape applied to the male threads only. Not more than three threads shall show after the joint is made up.
4. Brazed and soldered joints: Brazed and soldered joints for copper pipe and fittings shall conform to CDA A 4015. Silver solder or brazing alloys, ASTM B32, melting above 593 degrees C (1100 degrees F) shall be utilized.
5. Mechanical joints: Sleeve and grooved pipe couplings shall be installed and protected against corrosion as recommended by the

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- coupling manufacturer. Joints between nonmetallic and metallic carrier pipe shall be designed and furnished by the piping system manufacturer. The transition pieces shall be factory fabricated and shall be designed so that no field chemical welding of the carrier pipe will be required. Transitional joint connections to manhole steel piping shall be made inside the manhole except for prefabricated, pre-piped manholes where joints shall be outside the manhole wall.
6. Insulating joints and dielectric fittings: Shall be installed where shown.
  7. Nonmetallic pipe joints: Nonmetallic pipe joints shall be installed in accordance with the written instructions of the manufacturer.
- J. Above Ground Piping: (Above grade Exterior, Tunnels, Pipe Basement, Crawl Space)
1. Contractors option in lieu of field insulated chilled water piping.
  2. Factory prefabricated (preinsulated with factory installed PVC jacket covered with field installed metal jacket) sections with field insulated joints and fittings.
  3. Inner Carrier Pipe: Sched 80 PVC, Steel or copper.
  4. Joints and Fittings: Screwed, welded, Solvent weld, mechanical joint or solder as specified in this section.
  5. Support Saddles: Provide for piping supported on trapeze or similar bar type support. Fasten the support shield to the pipe with a 19 mm (3/4-inch) wide stainless steel band near each end.
- K. Pipe fittings for PVC pipe:
1. Below Grade: PVC or cast iron. Make PVC fittings of the same type and grade material as the piping to which they will be connected. PVC fittings shall be furnished by the manufacturer who supplies the pipe with approval based on NSF Standard No. 14. All fittings shall have temperature and pressure ratings not less than the adjoining piping and shall be designed and fabricated with bells for use with rubber ring gaskets. Cast iron fittings shall conform to AWWA C110. Adapter fittings for other piping materials shall be furnished by the manufacturer who supplies the pipe. Mechanical joints shall not be installed in above-ground systems unless otherwise approved. Joints shall be installed in accordance with the manufacturer's instructions.



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2. Above Grade: Make PVC fittings of the same type and grade material as the piping to which they will be connected. PVC fittings shall be Schedule 40 pressure pipe fittings with solvent weld joints. Joint surfaces shall be clean and free from moisture. A purple primer that conforms to ASTM F 656 shall be applied. Solvent cement not purple in color and conforming to ASTM D 2564 or CSA-B137.3 shall be applied to all joint surfaces. The joint shall be made while the cement is wet and shall be in accordance with ASTM D 2855. Solvent-cement joints shall be permitted above ground only.
3. Flanges and flanged fittings: All flanges shall be flat faced.
  - a. Cast-iron threaded flanges shall conform to ANSI B16.1, 125 pound.
  - b. Welded steel flanges shall conform to ANSI B16.5, Class 150.
  - c. Bronze flanges shall conform to ANSI B16.24, 150 pound.
  - d. PVC flanges shall conform to the dimensions of ANSI B16.5, Class 150.
4. Transitional joints: Carrier pipe joints between nonmetallic and metallic pipe shall be furnished by the piping system manufacturer and shall conform to the manufacturer's specifications.
5. Gaskets: Elastomeric seals shall conform to ASTM F477.

#### **2.19 THRUST BLOCKING FOR UNDERGROUND PREINSULATED CHILLED WATER PIPING**

- A. Thrust Blocking: Provide in all systems using the rubber ring method of joining the carrier pipe sections.
  1. Thrust Blocks shall be installed at the locations shown on the drawings or recommended by the pipe system manufacturer. Thrust blocks may not be required on all systems, and the need for thrust blocks shall be as recommended by the system manufacturer. Thrust blocks, if necessary, shall be installed at all changes in direction, changes in size, valves and terminal ends, such as plugs, caps and tees. Thrust blocks shall be concrete having a compressive strength of not less than 13780 kPa (2000 psi) after 28 days and shall be in accordance with Section 03 30 00, CAST-IN-PLACE CONCRETE. Thrust blocks shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and the thrust bearing sides of the thrust blocks shall be poured directly against undisturbed earth. The sides of the thrust blocks not subject to thrust may be poured against forms. Thrust

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blocks shall be placed so that the joints for all fittings will be accessible for repair wherever possible. No pipe joint shall be embedded in concrete. The thrust blocks shall provide for transfer of thrusts and reactions without exceeding the allowable stress of the concrete and shall be installed in accordance with pipe manufacturer's instructions. In muck or peat, all thrusts shall be resisted by piles or tie rods to solid foundations or by removal of peat or muck shall be replaced with ballast of sufficient stability to resist thrusts.

2. The area of backing required for reaction backing of both supply and return piping shall be calculated in accordance with Tables 1 and 2. The safe soil bearing load shall be determined for each site. Calculations covering these determinations shall be submitted to the Contracting Officer for approval prior to placing any reaction backing on the job.

**Table 1:** Thrust (Two Pipes), 1550 kPa (225 psig), and Class 1033 kPa (150 psig):

Pipe Size	Tees	90 Degree Bends	45 Degree Bends	22-1/2 Degree Bends
75 mm (3-inch)	5,670	8,050	4,360	2,180
100 mm (4-inch)	6,820	11,750	6,390	3,240
150 mm (6-inch)	7,050	24,200	13,200	6,620

**Table 2:** Safe Soil Bearing Loads:

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Soil	kPa	(psf)
*Muck, peat	0	0
Soft clay	47.9	1,000
Sand	95.8	2,000
Sand and gravel	143.7	3,000
Sand and gravel in clay matrix	191.6	4,000
Hard shale	479.0	10,000

\*In muck or peat, all thrusts shall be resisted by piles or tie rods to solid foundations or by removal of peat or muck which will be replaced with ballast of sufficient stability to resist thrusts.

## **2.20 ANCHORS FOR PREINSULATED CHILLED WATER PIPING**

Anchor design shall be in accordance with the published data of the manufacturer and for prefabricated systems shall be factory fabricated by the system manufacturer. In all cases, the design shall be such that water penetration, condensation, or vapor transmission will not wet the insulation.

## **2.21 REINFORCING STEEL**

Reinforcing steel shall be deformed bars, ASTM 615, Grade 40, unless otherwise noted.

## **2.22 BURIED UTILITY WARNING TAPE**

Tape shall be 0.1 mm (0.004 inch) thick, 150 mm (6 inches) wide, yellow polyethylene with a ferrous metallic core, acid and alkali-resistant and shall have a minimum strength of 12,000 kPa (1750 psig) lengthwise and 10,300 kPa (1500 psig) crosswise with an elongation factor of 350 percent. Provide bold black letters on the tape identifying the type of system. Tape color and lettering shall be unaffected by moisture and other substances contained in the backfill material.

# **PART 3 - EXECUTION**

## **3.1 GENERAL**

- A. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost to

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the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

- B. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- C. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION. Install heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.
- D. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (one inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.
- E. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.
- F. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.
- G. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.
- H. Provide manual air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.

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- I. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
  - 1. Water treatment pot feeders and condenser water treatment systems.
  - 2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- J. Thermometer Wells: In pipes 65 mm (2-1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.
- K. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC, and BOILER PLANT INSULATION.
- L. Where copper piping is connected to steel piping, provide dielectric connections.

### **3.2 PIPE JOINTS**

- A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- B. Screwed: Threads shall conform to ASME B1.20; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- C. Mechanical Joint: Pipe grooving shall be in accordance with joint manufacturer's specifications. Lubricate gasket exterior including lips, pipe ends and housing interiors to prevent pinching the gasket during installation. Lubricant shall be as recommended by coupling manufacturer.
- D. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.
- E. Solvent Welded Joints: As recommended by the manufacturer.

### **3.3 INSTALLATION OF PREINSULATED CHILLED WATER PIPING**

- A. Handling and Storage: Handle and store conduits, pipes, and all accessories to ensure complete installation in a sound undamaged condition. Unloading, tacking, moving, and storing of materials shall be in strict accordance with the manufacturer's requirements. Take special care to ensure that materials which have exceeded their

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specified shelf life are not used in the installation of the system. Before installation all materials shall be inspected for defects. Materials found to be defective before or after installation shall be repaired or replaced with sound material, with no additional expense to the Government.

B. Installation of Piping Systems:

1. Piping system furnished shall be installed in accordance with the piping system manufacturer's instructions. Piping shall be installed without springing or forcing other than what has been calculated for thermal expansion and contraction. Pipe ends shall have burrs removed by reaming and shall be installed to permit free expansion and contraction without damage to joints or hangers. Nonmetallic pipe cut in the field shall be machined to fit couplings or joints and shall be coated or treated to match standard factory coated ends. Copper tubing shall not be installed in the same trench with ferrous piping materials. When nonferrous metallic pipe (e.g., copper tubing) crosses any ferrous piping material, a minimum vertical separation of 300 mm (12 inches) shall be maintained between pipes. Connections between different types of pipe and accessories shall be made with transition fittings approved by the manufacturer of the piping system.
2. Pitching of horizontal piping: Horizontal piping shall be pitched at a grade not less than 25 mm (1 inch) in 12 m (40 feet) toward the drain points unless otherwise indicated.
3. Install vacuum and air relief valves, as required, for filling and draining of the system.

C. Pipe Sleeves:

1. Pipe shall be continuous through sleeves. Set in place before concrete is poured.
2. Seal between sleeve and core opening with modular mechanical type link seal.
3. Provide where water lines pass through retaining walls and foundation walls.

D. Cutting of Prefabricated Conduit Sections: Prefabricated conduit sections shall be cut in strict accordance with the manufacturer's recommendations and standards. The cut section shall be treated as

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required to result in the cut section being identical in every respect to a standard conduit section produced at the factory.

- E. Field Casing Closures: Field insulation and encasement of joints shall be accomplished after the visual and pressure tests specified are completed. Field insulation and encasement shall be in accordance with the manufacturer's written instructions. Thickness dimensions of the insulation and casing materials shall not be less than those of the adjoining prefabricated section. Insulating material may be foamed in place polyurethane or premolded polyurethane foam sections. Care should be taken to ensure that field closures are made under conditions of temperature and cleanliness required to produce a sound continuous vapor barrier. A standard polyethylene heat shrink sleeve shall be installed over the casing and shall have a 150 mm (6-inch minimum) overlap at each end.
- F. Insulation and Encasement of Pipe Accessories: Flanges, couplings, unions, valves, fittings, and other pipe accessories, unless otherwise shown or approved, shall be insulated with removable factory premolded, prefabricated or field fabricated insulation. For accessories buried underground, the casing material and thickness shall be identical to that of the adjoining casing material and thickness shall be identical to that of the adjoining casing except that for polyethylene casing larger than 300 mm (12-inch) size, the casing material over fittings shall be reinforced thermosetting resin (RTRP). For accessories in manholes, the casing material shall be steel or aluminum sheet applied over the insulation. Where accessories are designated not to be insulated, the adjoining insulation and jacket shall terminate neatly and in a manner to provide a complete vapor seal.
- G. Trenching and Backfilling: Trench bottoms for underground prefabricated conduit systems shall be smooth and free of sharp objects, stones, and debris that could puncture the casing. Where this is a problem, the trench should be over excavated and stabilized by using sand, fine dirt, or similar material. Partial backfilling is required immediately after installation of the pipe. Selected backfill shall be tamped in not more than 150 mm (6 inch) layers under and around the conduit to a height of not less than 150 mm (6-inch) above the top of the casing. During this process, joints shall be left exposed for visual inspection during field tests.



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- H. Open Ends: Open ends of pipe lines and equipment shall be properly capped or plugged during installation to keep dirt and other foreign matter out of the system.
- I. Vapor Barrier: Install materials to provide and preserve the integrity of the vapor barrier.

### **3.4 TESTING UNDERGROUND PREINSULATED CHILLED WATER PIPING**

- A. First Hydrostatic Test:
  - 1. All distribution piping shall be tested hydrostatically, before backfilling, with the joints of the water carrier pipe exposed. Installation of thrust blocks prior or after hydrostatic testing shall be as recommended by the pipe manufacturer's installation instructions.
  - 2. Each test cycle shall consist of a 10 minute period at 1034 kPa (150 psig) followed by a 5 minute period at a pressure less than 345 kPa (50 psig). The next cycle shall begin immediately following the completion of the previous cycle. Pressure rise and drop shall not exceed 690 kPa (100 psig) per minute. The pressure gage shall be located and the pressure measured at the opposite end of the system from where the pressure is applied. After completion of the hydrostatic pressure cycling the first hydrostatic pressure test may be performed.
- B. Final Hydrostatic Test: After successful completion of the first hydrostatic test, the system shall be pressurized to 1-1/2 times the working pressure up to 1034 kPa (150 psig). This pressure shall be held for a minimum of 4 hours. The method of pressurizing the piping system is to disconnect it from the system prior to the start of the 4-hour pressure holding period. If the pressure cannot be held for the specified length of time, the cause of the pressure loss shall be determined, corrected, and all the tests be repeated.
- C. Repair joints, replace damaged or porous pipe and fittings and repeat the test without additional cost to the Government until the system can be demonstrated to have no leakage.

### **3.5 LEAK TESTING ABOVEGROUND PIPING**

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the COR. Tests may be either of those below, or a combination, as approved by the COR.

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- B. An operating test at design pressure, and for hot systems, design maximum temperature.
- C. A hydrostatic test at 1.5 times design pressure. For water systems the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

### 3.6 FLUSHING AND CLEANING PIPING SYSTEMS

- A. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.
  - 1. Initial flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hidden areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/S (6 feet per second), if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the COR.
  - 2. Cleaning: Using products supplied in Section 23 25 00, HVAC WATER TREATMENT, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 1.8 m/S (6 feet

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per second). Circulate each section for not less than four hours. Blow-down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.

3. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

### **3.7 WATER TREATMENT**

- A. Install water treatment equipment and provide water treatment system piping.
- B. Close and fill system as soon as possible after final flushing to minimize corrosion.
- C. Charge systems with chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.
- D. Utilize this activity, by arrangement with the COR, for instructing VA operating personnel.

### **3.8 OPERATING AND PERFORMANCE TEST AND INSTRUCTION**

- A. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- B. Adjust red set hand on pressure gages to normal working pressure.

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