15110

Valves

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A. Summary

This section summarizes the design criteria for valves used in plumbing and HVAC systems. Valve requirements for steam, steam condensate, condenser water, chilled water, hot water glycol, and fuel oil services are shown in Tables 1 through 8.

Refer to Steam and Chilled Water Utilities Design Guidelines (SCUDG) for all utility piping going into building through and including the pressure reducing valve for steam or the chilled water.

B. System Design and Performance Requirements

1. General

- Cast or stamp the name of the manufacturer and guaranteed working pressure on the valve bodies.
- Valves of a similar type must be by a single manufacturer.
- Provide chain operators for valves 3” and larger that are installed 7’ or more above floor.
- Gaskets and packings must not contain asbestos.
- Frexatalic gaskets preferred on high temperature and high pressure applications.
- Ratings must include ANSI class rating and hole pattern for flanges.
- All steam system valves in steam and condensate piping must be gate or globe valves. Ball valves are not permitted. Butterfly valves are only acceptable with written authorization from the design professional.
2. **Butterfly Valves**

- Provide lug-style butterfly valves as shown in Tables 1 through 8. When required by the manufacturer, install valves in the proper direction for shutoff and dead-end service.
- General service valves must be ductile iron body and threaded-lug, with resilient EPDM seats, stainless steel disks, and 416 stainless stems.
- Valves 6" and larger must have gear operators.
- Valves small than 6” must have seven-position levers.
- If valves are used for fuel oil, provide reinforced Teflon seats and 316 stainless disks.
- For chilled water systems, select high-performance butterfly valves for isolation and shutoff applications on mains and branches over 4" in diameter.

3. **Ball Valves**

- Hot water systems should incorporate ball valves for isolation purposes.
- Ball valves may be used on chilled water lines that are 4" in diameter and smaller. The pressure rating must be per ANSI standard.
- Provide full-port, two-piece ball valves with reinforced Teflon seats, seals, bearings, stainless steel balls, and packing.
- Select 1-1/4" ball valves for drains.
- Valves on insulated piping must have 2" extended stems.
- All ball valves must have locking handles to allow servicing and removal of equipment.

4. **Globe Valves – To Be Approved by Northeastern University Prior to Construction Document Phase**

- Provide globe valves as shown in Tables 1 through 8.
- Refrigerant valves must be back-seating, globe stop valves, winged and sealed. 1" and under cap valves must have diaphragm packing.
5. **Plug Valves**
   - Provide plug valves with 70 percent port openings for balancing.
   - Provide gear operators with memory indicators.

6. **Check Valves**
   - Use silent and lift checks for heating hot water and chilled water systems.
   - Use swing checks for steam systems.

7. **Spring-Loaded Relief Valves**
   - Reliefs must be ASME-approved.
   - For water reliefs, pipe the discharge into an indirect drain. Where permitted by the building code, pipe chiller refrigerant and steam relief devices through the building envelope.

8. **Gate Valves**
   - Steam systems should incorporate gate valves for isolation purposes.
   - Provide gate valves as shown in Tables 1 through 8.
   - Gate valves may be used on 4" and smaller chilled water lines. The pressure rating must be per ANSI standard.
   - Select 1", full-port gate valves for vents.
   - In general, gate valves must have OS&Y rising stems to indicate position. For restricted clearances, gate valves must have non-rising stems. The contractor must submit the location where each type of gate valve is used.

9. **Serrated-Tip Laboratory Faucets**
   For use on laboratory faucets, serrated-tip laboratory faucets must have vacuum breakers.

**C. Manufacturers**
Subject to compliance with the design requirements, provide products by one of the following manufacturers:

1. **Butterfly Valves**
2. **Threaded and Soldered Ball Valves**
   - Stockham, B-22T series
   - Apollo
   - Hammond
   - Gates

3. **Globe Valves**
   a. 2" threaded and soldered valves:
      - Stockham, B-22T Series
      - Milwaukee
      - Apollo
      - Hammond
   b. 2" to 12" flanged valves:
      - Stockham, B-22T Series
      - Milwaukee
      - Apollo
      - Hammond
      - Zwick

4. **Plug Valves**
   - DeZurik
   - Carol Test
   - Kyro Test

5. **Check Valves**
   a. Check swing 2” threaded and soldered valves:
      - Stockham, B-22T Series
      - Milwaukee
      - Hammond
      - Zwick
   b. Check swing 2” to 12” flanged valves:
      - Stockham, B-22T Series
      - Milwaukee
• Nibco
• Apollo
• Hammond
• Zwick
c. Check lift 2” threaded and soldered valves:
  • Stockham, B-22T Series
  • Milwaukee
  • Nibco
  • Hammond

6. **Gate Valves**
   
a. 2” threaded, soldered, and flanged valves:
   • Stockham, B-22T Series
   • Milwaukee
   • Apollo
   • Hammond
   
b. 21/2” to 12” flanged valves:
   • Stockham, B-22T Series
   • Milwaukee
   • Apollo
   • Hammond
   • Zwick

7. **Laboratory Faucet Vacuum Breakers**
   • Nidel 3/8” (double-tight inline)
   • T&S BL-5550-8.2 (double-tight inline)

8. **Steam Heat Exchanger Vacuum Breakers**
   • Hoffman

9. **Steam Valves**
   • Jenkins
   • Stockham
   • Zwick

10. **Circuit Setters**
    • Armstrong
Bell & Gossett
Griswold
Tour Anderson

11. Balancing Valves

- Armstrong
- Bell & Gossett
- Griswold
- Tour Anderson

12. Triple Duty Valves

- Bell & Gossett

D. Materials

Combination balancing shut-off valves must be of bronze body or brass ball construction with glass and carbon-filled TFE seat rings. The valves must have differential pressure readout ports across the valve seat area. Readout ports must be fitted with internal EPT inserts and check valves. The valves must have memory stops to allow them to be closed for service, then reopened to setpoint without disturbing the balancing position. Balancing valves cannot be used for isolation valves.

E. Installation Guidelines

1. Distilled Water Systems

Avoid the use of snap-action valves and/or faucets.

2. Circuit Setters and Valves

- Circuit setters are required in the supply and return of heating hot water and chilled water coils.

- Valves are inexpensive compared to the function they perform. Provide a sufficient number of valves to isolate equipment for maintenance purposes by showing a valve between each piece of equipment on a loop or header.

- Install isolation valves on both sides of control valves and coils, and on the entering and leaving sides of equipment.

- Provide adequate balancing valves to facilitate and verify reliable
test and balance.

Northeastern University has experienced flooding from city sewers. When the potential for flooding exists, special attention to details (including the use of back-water valves) is required at basement and area drain installations. Back-water valves are not totally satisfactory, and their use should be limited to storm lines. A more satisfactory installation is the use of sump pumps and sewage ejectors.

4. Vacuum breakers
Equip water faucets having provisions for hose attachments with vacuum breaker back-flow preventers. Note that serrated-tip laboratory faucets are included in this category.

- Type (when available): Integral; (otherwise) vandal-proof spout-end.
- Angle should not be used on faucets because of spillage onto sink tops.

F. Reference Tables

<table>
<thead>
<tr>
<th>Table 1. Steam and Condensate Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam and Condensate Service</td>
</tr>
<tr>
<td>Maximum 90 psig Saturated Steam</td>
</tr>
<tr>
<td>Specialty</td>
</tr>
<tr>
<td>Ball valve</td>
</tr>
<tr>
<td>Gate valve</td>
</tr>
<tr>
<td>Globe valve</td>
</tr>
<tr>
<td>Butterfly valve</td>
</tr>
<tr>
<td>Plug valve</td>
</tr>
<tr>
<td>Check valve</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Strainer</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Vacuum breaker</td>
</tr>
</tbody>
</table>

1. These are minimum ratings. For actual maximum allowable valve and strainer ratings, refer to the documents listed under References.

2. SWP = Steam Working Pressure
WOG = Water, Oil, or Gas
WSP = Working Steam Pressure Class = ANSI Standard


Table 2. Steam and Condensate Service

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Application</th>
<th>Type</th>
<th>Size</th>
<th>Body/Seat Body/Trim</th>
<th>Connection</th>
<th>Minimum Rating 1, 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball valve</td>
<td>Isolation</td>
<td>OS&amp;Y</td>
<td>2-1/2&quot;–36&quot;</td>
<td>Iron/Bronze Iron/Iron</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Gate valve</td>
<td>Isolation</td>
<td>OS&amp;Y</td>
<td>2-1/2&quot;–10&quot;</td>
<td>Iron/Bronze</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Globe valve</td>
<td>Manual steam modulatio n only</td>
<td>Union Bonnet</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Stainless Bronze/Bronze</td>
<td>Threaded</td>
<td>250 psig SWP</td>
</tr>
<tr>
<td>Butterfly valve</td>
<td>Isolation</td>
<td>OS&amp;Y</td>
<td>2-1/2&quot;–10&quot;</td>
<td>Iron/Bronze</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Plug valve</td>
<td>Not used</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check valve</td>
<td>Steam and condensate horizontal flow</td>
<td>Non Y-Type swing check valve (15º angle)</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Teflon</td>
<td>Threaded (Use dielectrics for condensate)</td>
<td>250 psig WSP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2&quot;–30&quot;</td>
<td>Iron/Iron</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Strainer</td>
<td>Control valves and flow meters and steam traps</td>
<td>Y-Type</td>
<td>1/2&quot;–2&quot;</td>
<td>Iron/Stainless (1/16&quot; diameter)</td>
<td>Threaded</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2&quot;–10&quot;</td>
<td>Iron/Stainless (3/64&quot; diameter)</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12&quot;–24&quot;</td>
<td>Iron/Stainless (1/16&quot; diameter)</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Vacuum breaker</td>
<td>Steam coils and HX and condensate trap legs</td>
<td>Steam vacuum breaker</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Teflon</td>
<td>Threaded (Use dielectrics for condensate)</td>
<td>Class 250</td>
</tr>
</tbody>
</table>

1. These are minimum ratings. For actual maximum allowable valve and strainer ratings, refer to the documents listed under References.

2. SWP = Steam Working Pressure
   WOG = Water, Oil, or Gas WSP
   = Working Steam Pressure
   Class = ANSI Standard
### Table 3. Steam and Condensate Service

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Application</th>
<th>Type</th>
<th>Size</th>
<th>Body/Seat Body/Trim</th>
<th>Connection</th>
<th>Minimum Rating¹,²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball valve</td>
<td>Isolation</td>
<td>OS&amp;Y</td>
<td>2-1/2”–36”</td>
<td>Iron/Bronze</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Gate valve</td>
<td>Isolation</td>
<td>OS&amp;Y</td>
<td>2-1/2”–36”</td>
<td>Iron/Iron</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Globe valve</td>
<td>Manual steam modulation only</td>
<td>Union Bonnet</td>
<td>1/2”–2”</td>
<td>Bronze/Stainless</td>
<td>Threaded</td>
<td>250 psig SWP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OS&amp;Y</td>
<td>2-1/2”–10”</td>
<td>Bronze/Bronze</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Butterfly valve</td>
<td>Isolation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plug valve</td>
<td>Not used</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check valve</td>
<td>Steam and condensate horizontal flow</td>
<td>Non Y-Type swing check valve (15° angle)</td>
<td>1/2”–2”</td>
<td>Bronze/Teflon</td>
<td>Threaded (Use dielectrics for condensate)</td>
<td>250 psig WSP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2”–30”</td>
<td>Iron/Iron</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Strainer</td>
<td>Control valves and flow meters and steam traps</td>
<td>Y-Type</td>
<td>1/2”–2”</td>
<td>Iron/Stainless (1/16” diameter)</td>
<td>Threaded</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2”–10”</td>
<td>Iron/Stainless (3/64” diameter)</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12”–24”</td>
<td>Iron/Stainless (1/16” diameter)</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Vacuum breaker</td>
<td>Steam coils and HX and condensate trap legs</td>
<td>Steam vacuum breaker</td>
<td>1/2”–2”</td>
<td>Bronze/Teflon</td>
<td>Threaded (Use dielectrics for condensate)</td>
<td>Class 250</td>
</tr>
</tbody>
</table>

¹. These are minimum ratings. For actual maximum allowable valve and strainer ratings, refer to the documents listed under References.

². SWP = Steam Working Pressure
   WOG = Water, Oil, or Gas WSP
   = Working Steam Pressure
   Class = ANSI Standard
### Table 4. Glycol, Chilled, and Condenser Water Service

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Application</th>
<th>Type</th>
<th>Size</th>
<th>Body/Seat Body/Trim</th>
<th>Connection</th>
<th>Minimum Rating¹²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball valve</td>
<td>Isolation</td>
<td>Full port 2-pc.</td>
<td>1/2”–2”</td>
<td>Bronze/Teflon</td>
<td>Sweat¹</td>
<td>400 psig WOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full Port 2-pc.</td>
<td>1/2”–2”</td>
<td>Bronze/Teflon</td>
<td>Threaded</td>
<td>400 psig WOG</td>
</tr>
<tr>
<td>Gate valve</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Globe valve</td>
<td>ATC modulation</td>
<td>Control valve</td>
<td>1/2”–2”</td>
<td>Bronze/Metal</td>
<td>Threaded</td>
<td>400 psig WOG</td>
</tr>
<tr>
<td>Butterfly valve</td>
<td>Isolation</td>
<td>General service</td>
<td>2 1/2”–12”</td>
<td>Ductile iron/EPDM</td>
<td>Threaded Lug</td>
<td>150 psig WOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>175 psig CWP</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>150 psig dead-end service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>General service</td>
<td>14”–24”</td>
<td>Ductile iron/EPDM</td>
<td>Threaded Lug</td>
<td>150 psig CWP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>150 psig dead-end service</td>
</tr>
<tr>
<td>Plug valve</td>
<td>Throttling</td>
<td>Non-lubricated</td>
<td>3”–12”</td>
<td>Steel/Iron</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td>Check valve</td>
<td>Pumps</td>
<td>Silent</td>
<td>1/2”–2”</td>
<td>Bronze/Bronze</td>
<td>Threaded</td>
<td>200 psig WOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Silent globe</td>
<td>2-1/2”–24”</td>
<td>Iron/Bronze</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td>Piping</td>
<td>Y-Pattern swing</td>
<td></td>
<td>1/2”–2”</td>
<td>Bronze/Bronze</td>
<td>Threaded</td>
<td>200 psig WOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2”–24”</td>
<td>Iron/Bronze</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td>Strainer</td>
<td>Control valves and flow meters</td>
<td>Y-Type</td>
<td>1/2”–2”</td>
<td>Bronze/Stainless (1/16” diameter)</td>
<td>Threaded</td>
<td>200 psig WOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2”–4”</td>
<td>Iron/Stainless (1/16” diameter)</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5”–24”</td>
<td>Iron/Stainless (1/8” diameter)</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
</tbody>
</table>

¹ Minimum pressure rating is for non-lubricated valves and is calculated based on the maximum allowable working pressure (MAWP) of the valve body material and the service conditions.

² The 2-1/2”–24” size is recommended for high-pressure applications where additional holding power is required for system integrity.

³ Sweat connections are ideal for low-pressure systems and offer easy installation and maintenance.

⁴ Threaded connections are preferred for high-pressure systems due to their added strength and security.

⁵ Flanged connections are commonly used in industrial applications where high temperatures and pressures are involved, providing a secure seal and ease of installation and removal.

⁶ The use of non-lubricated valves is recommended in applications where contamination from lubricants is not allowed, ensuring clean and efficient operation.

⁷ The choice of material (e.g., steel/iron, bronze/bronze, etc.) is dependent on the service conditions (temperature, pressure, chemical resistance) and the specific requirements of the application.
Table 4. Glycol, Chilled, and Condenser Water Service—Continued

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Application</th>
<th>Type</th>
<th>Size</th>
<th>Body/Seat Body/Trim</th>
<th>Connection</th>
<th>Minimum Rating¹,²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strainer</td>
<td>Pump suction</td>
<td>In-line Y-Type</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Stainless (1/16&quot; diameter)</td>
<td>Threaded</td>
<td>200 psig WOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2&quot;–4&quot;</td>
<td>Iron/Stainless (3/16&quot; diameter)³</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5&quot;–24&quot;</td>
<td>Iron/Stainless (3&quot; diameter)³</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td>Angle suction</td>
<td>diffuser end suction pumps</td>
<td></td>
<td>2&quot;–12&quot;</td>
<td>Iron/Stainless (3/16&quot; diameter)³</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Startup strainer = 16 mesh bronze</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹. These are minimum ratings for ASTM A126, Class B and ASTM B-61 and 62. For higher pressures and temperatures, adjust these values to include static head plus 1.1 times pressure relief valve setting plus pump shutoff head pressure. For actual maximum allowable valve and strainer ratings, refer to "Pressure-Temperature Ratings - Non Shock" tables and "Adjusted Pressure Ratings" for copper tube, soldered end valves [and strainers].

². SWP = Steam Working Pressure
   CWP = Cold Water Working Pressure
   WSP = Working Steam Pressure
   WOG = Water, Oil or Gas
   Class = ANSI Standard

³. Use 1/8" diameter for plate heat exchanger application.
Table 5. Glycol, Chilled, and Condenser Water Service

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Application</th>
<th>Type</th>
<th>Size</th>
<th>Body/Seat Body/Trim</th>
<th>Connection</th>
<th>Minimum Rating (^1,2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball valve</td>
<td>Isolation</td>
<td>Full port 2-pc.</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Teflon</td>
<td>Threaded</td>
<td>600 psig WOG</td>
</tr>
<tr>
<td>Gate valve</td>
<td>Not used</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Globe valve</td>
<td>ATC modulation</td>
<td>Control valve</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Metal</td>
<td>Threaded</td>
<td>600 psig WOG</td>
</tr>
<tr>
<td>Butterfly valve</td>
<td>Isolation</td>
<td>High performance</td>
<td>2-1/2&quot;–24&quot;</td>
<td>Carbon steel/PTFE</td>
<td>Threaded lug</td>
<td>285 psig CWP</td>
</tr>
<tr>
<td>Plug value</td>
<td>Throttling</td>
<td>Non-lubricated</td>
<td>3&quot;–12&quot;</td>
<td>Steel/Iron</td>
<td>Flanged</td>
<td>Class 300</td>
</tr>
<tr>
<td>Check valve</td>
<td>Pumps</td>
<td>Silent</td>
<td>1&quot;–2&quot;</td>
<td>Bronze/Bronze</td>
<td>Threaded</td>
<td>Class 300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Silent globe</td>
<td>2-1/2&quot;–24&quot;</td>
<td>Iron/Bronze</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td>Piping</td>
<td>Y-Pattern swing</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Bronze</td>
<td>Threaded</td>
<td>Class 300</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2&quot;–24&quot;</td>
<td>Iron/Bronze</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Strainer</td>
<td>Control valves and flow meters</td>
<td>Y-Type</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Stainless (1/16&quot; diameter)</td>
<td>Threaded</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2&quot;–4&quot;</td>
<td>Iron/Stainless (1/16&quot; diameter)</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5&quot;–24&quot;</td>
<td>Iron/Stainless (1/8&quot; diameter)</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Pump suction</td>
<td>In-line Y-Type</td>
<td></td>
<td>1/2&quot;–2&quot;</td>
<td>Iron/Stainless (1/16&quot; diameter)</td>
<td>Threaded</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2&quot;–4&quot;</td>
<td>Iron/Stainless (3/16&quot; diameter)(^3)</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5&quot;–24&quot;</td>
<td>Iron/Stainless (3&quot; diameter)(^3)</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
</tbody>
</table>
Table 5. Glycol, Chilled, and Condenser Water Service—Continued

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Application</th>
<th>Type</th>
<th>Size</th>
<th>Body/Seat Body/Trim</th>
<th>Connection</th>
<th>Minimum Rating¹,²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strainer</td>
<td>Pump suction</td>
<td>Angle suction diffuser end suction pumps</td>
<td>2”–12”</td>
<td>Iron/Stainless (3/16” diameter)³</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
</tbody>
</table>

1. These are minimum ratings. For higher pressures and temperatures, adjust these values to include static head plus 1.1 times pressure relief valve setting plus pump shutoff head pressure. For actual maximum allowable valve and strainer ratings, refer to "Pressure-Temperature Ratings - Non Shock" tables.

2. SWP = Steam Working Pressure  
   CWP = Cold Water Working Pressure  
   WSP = Working Steam Pressure  
   WOG = Water, Oil or Gas  
   Class = ANSI Standard

3. Use 1/8” diameter for plate heat exchanger application.
<table>
<thead>
<tr>
<th>Specialty</th>
<th>Application</th>
<th>Type</th>
<th>Size</th>
<th>Body/Seat Body/Trim</th>
<th>Connection</th>
<th>Minimum Rating¹,²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball valve</td>
<td>Isolation</td>
<td>Full port 2- pc.</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Teflon</td>
<td>Sweat¹</td>
<td>400 psig WOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full port 2- pc.</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Teflon</td>
<td>Threaded</td>
<td>400 psig WOG</td>
</tr>
<tr>
<td>Gate valve</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Globe valve</td>
<td>ATC modulation</td>
<td>Control valve</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Metal</td>
<td>Threaded</td>
<td>400 psig WOG</td>
</tr>
<tr>
<td>Butterfly valve</td>
<td>Isolation</td>
<td>General service</td>
<td>2-1/2&quot;–12&quot;</td>
<td>Ductile Iron/EPDM</td>
<td>Threaded lug</td>
<td>200 psig CWP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>14&quot;–24&quot;</td>
<td>Ductile Iron/EPDM</td>
<td>Threaded lug</td>
<td>200 psig bi-</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>directional</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>shutoff</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>200 psig dead</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>end service</td>
</tr>
<tr>
<td>Plug valve</td>
<td>Throttling</td>
<td>Non-lubricated</td>
<td>3&quot;–12&quot;</td>
<td>Steel/Iron</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td>Check valve</td>
<td>Pumps</td>
<td>Silent</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Bronze</td>
<td>Threaded</td>
<td>200 psig WOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Silent globe</td>
<td>2-1/2&quot;–24&quot;</td>
<td>Iron/Bronze</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td></td>
<td>Piping</td>
<td>Y-Pattern swing</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Bronze</td>
<td>Threaded</td>
<td>200 psig WOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2&quot;–24&quot;</td>
<td>Iron/Bronze</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td>Strainer</td>
<td>Control valves and</td>
<td>Y-Type</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Stainless</td>
<td>Threaded</td>
<td>200 psig WOG</td>
</tr>
<tr>
<td></td>
<td>flow meters</td>
<td></td>
<td></td>
<td>(1/16&quot; diameter)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump suction</td>
<td>In-line Y-Type</td>
<td></td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Stainless</td>
<td>Threaded</td>
<td>200 psig WOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1/16&quot; diameter)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ psi: Pounds per square inch
² WOG: Working Operating Pressure
### Table 6. Hot Water Service—Continued

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Application</th>
<th>Type</th>
<th>Size</th>
<th>Body/Seat Body/Trim</th>
<th>Connection</th>
<th>Minimum Rating¹,²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strainer</td>
<td>Pump suction</td>
<td>In-line Y-Type</td>
<td>2-1/2&quot;–4&quot;</td>
<td>Iron/Stainless (3/16&quot; diameter)³</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5&quot;–24&quot;</td>
<td>Iron/Stainless (3&quot; diameter)³</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td>Angle suction</td>
<td>Diffuser end suction</td>
<td>2&quot;–12&quot;</td>
<td></td>
<td>Iron/Stainless (3/16&quot; diameter)³</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td></td>
<td>pumps</td>
<td></td>
<td></td>
<td>Startup strainer = 16 mesh bronze</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹. These are minimum ratings for ASTM A126, Class B and ASTM B-61 and 62. For higher pressures and temperatures, adjust these values to include static head plus 1.1 times pressure relief valve setting plus pump shutoff head pressure. For actual maximum allowable valve and strainer ratings, refer to "Pressure-Temperature Ratings - Non Shock" tables and "Adjusted Pressure Ratings" for copper tube, soldered end valves [and strainers].

². SWP = Steam Working Pressure
   CWP = Cold Water Working Pressure
   WSP = Working Steam Pressure
   WOG = Water, Oil or Gas
   Class = ANSI Standard

³. Use 1/8" diameter for plate heat exchanger application.
Table 7. Hot Water Service

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Application</th>
<th>Type</th>
<th>Size</th>
<th>Body/Seat Body/Trim</th>
<th>Connection</th>
<th>Minimum Rating1,2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball valve</td>
<td>Isolation</td>
<td>Full port 2- pc.</td>
<td>1/2”–2”</td>
<td>Bronze/Teflon</td>
<td>Sweat³</td>
<td>Do not use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full port 2- pc.</td>
<td>1/2”–2”</td>
<td>Bronze/Teflon</td>
<td>Threaded</td>
<td>600 psig WOG</td>
</tr>
<tr>
<td>Gate valve</td>
<td>Not used</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Globe valve</td>
<td>ATC modulation</td>
<td>Control valve</td>
<td>1/2”–2”</td>
<td>Bronze/Metal</td>
<td>Threaded</td>
<td>600 psig WOG</td>
</tr>
<tr>
<td>Butterfly valve</td>
<td>Isolation</td>
<td>High performance</td>
<td>2-1/2”–24”</td>
<td>Carbon steel/PTFE</td>
<td>Threaded lug</td>
<td>740 psig CWP</td>
</tr>
<tr>
<td>Plug valve</td>
<td>Throttling</td>
<td>Non-lubricated</td>
<td>3”–12”</td>
<td>Steel/Iron</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Check valve</td>
<td>Pumps</td>
<td>Silent</td>
<td>1”–2”</td>
<td>Bronze/Bronze</td>
<td>Threaded</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Silent globe</td>
<td>2-1/2”–24”</td>
<td>Iron/Bronze</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Piping</td>
<td>Y-Pattern swing</td>
<td></td>
<td>1”–2”</td>
<td>Bronze/Bronze</td>
<td>Threaded</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2”–24”</td>
<td>Iron/Bronze</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td>Strainer</td>
<td>Control valves and</td>
<td>Y-Type</td>
<td>1/2”–2”</td>
<td>Bronze/Stainless</td>
<td>Threaded</td>
<td>600 psig WOG</td>
</tr>
<tr>
<td></td>
<td>flow meters</td>
<td></td>
<td></td>
<td>(20 mesh)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 1/2”–4”</td>
<td>Iron/Stainless</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1/16” diameter)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5”–24”</td>
<td>Iron/Stainless</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1/8” diameter)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump suction</td>
<td>In-line Y-Type</td>
<td></td>
<td>1/2”–2”</td>
<td>Bronze/Stainless</td>
<td>Threaded</td>
<td>600 psig WOG</td>
</tr>
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<td></td>
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<td>(1/16” diameter)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2”–4”</td>
<td>Iron/Stainless</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(3/16” diameter)³</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5”–24”</td>
<td>Iron/Stainless</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(3” diameter)³</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 7. Hot Water Service—Continued

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Application</th>
<th>Type</th>
<th>Size</th>
<th>Body/Seat Body/Trim</th>
<th>Connection</th>
<th>Minimum Rating¹,²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strainer</td>
<td>Pump suction</td>
<td>Angle suction diffuser end suction pumps</td>
<td>2”–12”</td>
<td>Iron/Stainless (3/16” diameter)³ Startup strainer = 16 mesh bronze</td>
<td>Flanged</td>
<td>Class 250</td>
</tr>
</tbody>
</table>

1. These are minimum ratings for ASTM A126, Class B and ASTM B-61 and 62. For higher pressures and temperatures, adjust these values to include static head plus 1.1 times pressure relief valve setting plus pump shutoff head pressure. For actual maximum allowable valve and strainer ratings, refer to "Pressure-Temperature Ratings - Non Shock" tables and "Adjusted Pressure Ratings" for copper tube, soldered end valves [and strainers].

2. SWP = Steam Working Pressure
   CWP = Cold Water Working Pressure
   WSP = Working Steam Pressure
   WOG = Water, Oil or Gas
   Class = ANSI Standard

3. Use 1/8” diameter for plate heat exchanger application.
Table 8. Hot Water Service

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Application</th>
<th>Type</th>
<th>Size</th>
<th>Body/Seat Body/Trim</th>
<th>Connection</th>
<th>Minimum Rating&lt;sup&gt;1,2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball valve</td>
<td>Isolation</td>
<td>Full port 3-pc.</td>
<td>1/2&quot;–2&quot;</td>
<td>Carbon steel/PTFE</td>
<td>Threaded</td>
<td>250 psig WSP</td>
</tr>
<tr>
<td>Gate valve</td>
<td>Isolation</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Metal</td>
<td>Threaded</td>
<td>Class 125</td>
<td></td>
</tr>
<tr>
<td>Globe valve</td>
<td>ATC modulation</td>
<td>Control valve</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Metal</td>
<td>Threaded</td>
<td>400 psig WOG</td>
</tr>
<tr>
<td>Butterfly valve</td>
<td>Not used</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plug valve</td>
<td>Throttling</td>
<td>Non-lubricated</td>
<td>3&quot;–12&quot;</td>
<td>Steel/Iron</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td>Check valve</td>
<td>Piping Y-Part pattern swing</td>
<td>Y-Type</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Bronze</td>
<td>Threaded</td>
<td>200 psig WOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2&quot;–24&quot;</td>
<td>Iron/Bronze</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td>Strainer</td>
<td>Control valves and flow meters</td>
<td>Y-Type</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Stainless (1/16&quot; diameter)</td>
<td>Threaded</td>
<td>200 psig WOG</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-1/2&quot;–4&quot;</td>
<td>Iron/Stainless (1/16&quot; diameter)</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5&quot;–24&quot;</td>
<td>Iron/Stainless (1/8&quot; diameter)</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
<tr>
<td>Pump suction</td>
<td>In-line Y-Type</td>
<td>1/2&quot;–2&quot;</td>
<td>Bronze/Stainless (1/16&quot; diameter)</td>
<td>Threaded</td>
<td>200 psig WOG</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-1/2&quot;–4&quot;</td>
<td>Iron/Stainless (3/16&quot; diameter)</td>
<td>Flanged</td>
<td>Class 125</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5&quot;–24&quot;</td>
<td>Iron/Stainless (3&quot; diameter)</td>
<td>Flanged</td>
<td>Class 125</td>
<td></td>
</tr>
</tbody>
</table>
Table 8. Hot Water Service—Continued

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Application</th>
<th>Type</th>
<th>Size</th>
<th>Body/Seat Body/Trim</th>
<th>Connection</th>
<th>Minimum Rating(^{1,2})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strainer</td>
<td>Pump suction</td>
<td>Angle suction diffuser end suction pumps</td>
<td>2“–12”</td>
<td>Iron/Stainless (3/16” diameter)</td>
<td>Flanged</td>
<td>Class 125</td>
</tr>
</tbody>
</table>

1. These are minimum ratings for ASTM A126, Class B and ASTM B-61 and 62. For higher pressures and temperatures, adjust these values to include static head plus 1.1 times pressure relief valve setting plus pump shutoff head pressure. For actual maximum allowable valve and strainer ratings, refer to "Pressure-Temperature Ratings - Non Shock" tables.

2. SWP = Steam Working Pressure
   CWP = Cold Water Working Pressure
   WSP = Working Steam Pressure
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-END-
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Gauges

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A. Summary

This section contains design criteria for meters and gauges.

B. System Design and Performance Requirements

1. Pressure gauges must be bronze Bourdon tube-type, accurate to ±1 percent.

2. Pressure gauges must be easily accessible and easily read. Gauges readable from the floor at less than 5' must have 4-1/2" dials. Other gauges must have 6" dials. Gauge graduations must meet the limit requirements of normal operation. Gauges must indicate at mid-scale.

3. Thermometers must have a 9" scale and white face with black-filled engraved letters. Thermometers must be angular or straight-stemmed, as conditions necessitate.

4. Combination pressure and temperature (P/T) test plugs must be 1/4" or 1/2" NPT. Plugs must be rated at zero leakage from vacuum to 1000 psig.
C. Manufacturers

Subject to compliance with the design requirements, provide products by one of the following manufacturers: Faceplate readings shall reflect designed working temperatures and pressures. The gauges shall read either 20 psi or 20°F above or below design values.

1. Pressure gauges:
   - U.S. Gauge
   - Trerice
   - Ashcroft

2. Thermometers:
   - U.S. Gauge
   - Trerice
   - Ashcroft

3. Combination pressure and temperature (P/T) test plugs:
   - Peter Equipment Company “Petes Plug”
   - Sisco, Inc. “P/T Plugs”

D. Materials

1. Thermometer wells must be bronze, non-mercury filled.

2. Combination pressure and temperature (P/T) test plugs must be constructed of solid brass with a Nordel valve core suitable for temperatures up to 350°F.

3. Gauges must have white faces with black-filled, engraved lettering. Gauge bodies must be set in phenolic cases. Provide siphons and shut-off cocks and pigtails for each pressure gauge.

E. Accessories or Special Features

Provide combination pressure and temperature (P/T) test plugs with extension fittings for each plug suitable for use with 2" maximum pipe insulation.
F. **Installation Guidelines**

1. Install thermometer wells to ensure the minimum restriction of water flow in the pipe.

2. Provide access for reading gauges.

3. To facilitate performance verification and for on-going operation and maintenance, provide sufficient temperature and pressure gauges and flow meters beyond that necessary to control the systems.

4. Provide pressure and temperature (P/T) test plugs close to the controlling sensors for verifying their calibration.

-END-
15140

Domestic Water Piping

This document provides design standards only, and is not intended for use, in whole or in part, as a specification. Do not copy this information verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of this document to the Northeastern University Project Manager.

A. Summary

This section contains design criteria for domestic water systems piping within a facility.

B. System Design and Performance Requirements

1. The maximum water velocity in piping must not exceed 5 feet per second.
2. Provide water shock absorbers at all flush valves and other locations where sudden valve closures would cause water hammer. Do not use capped air columns, which become water logged after a period of time.
3. The maximum static water pressure at fixtures must be 75 psig. Provide pressure reducing valves where static pressure exceeds 75 psig.
4. For large plan spaces, such as laboratories, consider a looped piping system to facilitate changes to the system and provide redundancy of feed and constant pressure to all areas.
5. Provide adequate expansion loops and anchors.
6. Be sure building service connections coordinate with the HVAC equipment.
7. Provide freeze protection for exterior water lines, such as cooling tower feeds.
8. Install hose bibs in all machinery rooms, kitchens, and in all rooms containing floor drains but no water-supplied fixtures.
9. Design professional(s) shall review city water pressure at a nearby city water hydrant. Northeastern Fire Marshal’s office maintains hydrant test data for 2 years. If not available, design professional(s) shall request a hydrant test. Copy of test shall be included in design development package along with pressure calculations. This will determine if a domestic water pressure booster pump(s) are required.

C. Submittals
Submit the following design and construction documentation.

1. Designer Submittals
   Submit domestic water load and non-potable load calculations with sketch.

2. Construction Documents
   Submit pipe cleaning and pipe pressure test reports.

D. Materials
All interior copper water piping above grade must be Type L only.

1. Domestic Cold Water
   Maximum operating limits: 100 psig, 250 °F maximum temperature: copper

2. Domestic Hot Water
   Maximum operating limits: 100 psig, 250 °F maximum temperature: copper

3. Domestic Hot Return
   Maximum operating limits: 100 psig, 250 °F maximum temperature: copper

4. Non-Potable Water
   Maximum operating limits: 100 psig, 250 °F maximum temperature: copper
E. Installation Guidelines

1. Install an isolation valve on each piping riser.
2. Install drain valves with 3/4” hose connections and caps at all low points in the system.
3. To prevent transmitting vibrations through the piping system, install flexible connections on piping connected to vibrating equipment.
4. Do not install plumbing piping in transformer vaults, switchboard rooms, data centers or telephone rooms.
5. Install frost-proof hose bibs every 100 ft around the building, on the roof for washing down air handling unit coils, and in mechanical rooms.
6. Do not use mechanical joining components.

-END-
15150

Sanitary or Laboratory Waste and Vent Piping

This document provides design standards only, and is not intended for use, in whole or in part, as a specification. Do not copy this information verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of this document to the Northeastern University Project Manager.

A. Summary

This section contains design criteria for sanitary, laboratory waste, and vent systems piping within a facility.

B. System Design and Performance Requirements

1. Use cast iron or copper Type M drain lines for sanitary drainage. Plastic or copper will radiate noise more readily to the surrounding spaces. Acid waste piping to be utilized in lab drainage.

2. The lab waste drainage and vent piping system must be separate from the domestic sanitary waste and vent system until after lab waste neutralization system tanks. Laboratory wastes and animal cage washroom floor drains must pass through the neutralization system.

3. All condensate from air conditioning equipment and other HVAC drains, including cooling tower overflow and drain, must go to the sanitary sewer system. The use of condensate pumps is approved.
   a. There must be an indirect connection between air conditioning equipment drain piping and the sanitary plumbing system.
   b. All traps must be deep seal type and provide trap primers where deemed necessary.
   c. Open-sight drains, if used, must not be in concealed spaces. Provide trap primers for drains.
4. The following requirements apply to the condensate drains from cooling coils and to the drains from sections of air conditioning units and plenums.
   a. All fan coils must have condensate drain lines, even if designed for sensible cooling only. Provide a sufficient number of unit drain risers to permit a slope in the horizontal drain lines of at least one inch per 40 feet. The minimum horizontal drain must be 3/4 inches in diameter. As a general rule, the maximum horizontal run must be 40 feet. The use of condensate pumps is authorized.
   b. As a general rule, avoid condensate drainage directly through the wall to the ground.

C. Submittals
Submit the following design and construction documentation.

1. Designer Submittals
   Submit sanitary and laboratory fixture count calculations with sketch.

2. Construction Documents
   Submit pipe cleaning and pipe pressure test reports.

D. Materials

1. Sanitary Waste and Vent Piping
   Gravity flow, 120°F maximum temperature, cast iron pipe.

2. Force Main
   Maximum operating limits: 50 psig, galvanized steel.

3. Lab Vent Piping
   Gravity flow, 100°F maximum temperature, polypropylene.

4. Lab Waste Piping
   Gravity flow, 120°F maximum temperature, polypropylene.

5. Lab Waste Forced Main
   150 psig, 120°F maximum temperature, polypropylene.
E. Installation Guidelines

1. Maintain air gaps, as required by code, where indirect waste discharges into traps or funnel drains.

2. Provide floor drains with trap primers at the following locations:
   a. At fire protection riser alarm valves and at test-and-drain valves when not discharged through a wall.
   b. At pumps, refrigeration compressors, air compressors, vacuum pumps, boilers, water heaters, air conditioning equipment, water softeners, and other locations as required.
   c. In kitchens near dishwashers, steam kettles, large refrigerators, and at other locations as required.

-END-
15160

Storm Drainage Piping

This document provides design standards only, and is not intended for use, in whole or in part, as a specification. Do not copy this information verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of this document to the Northeastern University Project Manager.

A. Summary

This section contains design criteria for storm drainage system piping within a facility.

B. System Design and Performance Requirements

1. 1/4”/ft slope (minimum).

2. Where slope is not feasible, locate drains below the adjacent roof surface near the center of structural framing bays, but not near columns, girders, and intersections with vertical surfaces. Drain size must be 3” IPS (minimum), with strainer.

3. When the roof area is surrounded by parapet walls, provide emergency overflow scupper drains, as required by code, in addition to interior drains. The bottom of the scupper, if used, must be above the top of the cant strip (or 4” above the top of the roof surface at the drain).

4. Use the latest code or BOCA Basic Plumbing Code-2003, whichever is more stringent, for 2” rainfall per hour for a 1-hour duration and a 100-year return period.
C. **Submittals**

Submit the following design and construction documentation.

1. **Designer Submittals**
   Submit storm roof drain sizing calculations with sketch.

2. **Construction Documents**
   Submit pipe cleaning and pipe pressure test reports.

D. **Materials**

1. Use cast iron drain lines where noise is a consideration. Plastic or copper radiates noise more readily to surrounding spaces. Acid waste piping approved for lab applications.

2. Storm drain: gravity flow, 80°F maximum temperature, cast iron pipe.

E. **Installation Guidelines**

1. Take below-grade clear water drains to a sump pit. Use duplex sump pumps to pump the water into the gravity house drain.

2. Take footing drains through a sediment interceptor before connecting them to a sump pit.

3. Provide insulation on storm drain piping based on acoustical considerations (i.e. theaters, museums, libraries, etc.)

4. Provide insulation on storm drain piping that passes through an environment that may cause condensation.

-**END**-
15181

Hydronic Piping

This document provides design standards only, and is not intended for use, in whole or in part, as a specification. Do not copy this information verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of this document to the Northeastern University Project Manager.

A. Summary

This section contains design criteria for hydronic heating and cooling system piping and specialties within a facility.

B. System Design and Performance Requirements

1. Design piping, hangers, and braces for seismic zone 2. The hanger supplier is not responsible for seismic design. The engineer is responsible for the design of anchors, thrust restraints, guides, and similar components.

2. Include pipe marking requirements in the project specifications. See Section 15075, Mechanical Identification. Underground systems design must include buried identification and warning tape for damage prevention.

3. Underground systems design requires an evaluation of cathodic protection. If needed, the engineer will design these systems, not the vendor.

4. Leak detection is generally not required on underground chilled water systems.

5. For large plan spaces, such as laboratories, consider a looped piping system to facilitate changes to the system and provide redundancy of feed and constant pressure to all areas.

6. Provide adequate expansion loops and anchors.
7. Water velocity and pressure drop limits.
   a. Water velocity over occupied spaces.
      (1) 4 fps is the maximum water velocity for 2" and smaller piping.
      (2) 8 fps is the maximum water velocity for 2-1/2" and larger piping to minimize water noise.
   b. Water velocity over equipment or unoccupied spaces.
      (1) 4 fps is the maximum water velocity for 2" and smaller piping.
      (2) 8 fps is the maximum velocity for 2-1/2" and larger piping.
   c. Minimum velocity and pressure drop for air removal.
      (1) 1-1/2 to 2 fps is the minimum velocity for 2" and smaller piping.
      (2) 0.75 ft/100 ft is the minimum pressure drop for 2-1/2" and up piping.
   d. The maximum pressure drop is 4 ft/100 ft.

C. Submittals
Submit the following design and construction documentation.

1. Designer Submittals
   Submit heating and cooling load calculations, with sketch, for heating hot water, chilled water, and condenser water systems.

2. Construction Documents
   Submit pipe cleaning and pipe pressure test reports.

D. Manufacturers
Manufacturers to be discussed with Northeastern and approved prior to formal print.

E. Materials—Chilled Water Piping
Pipe and fittings must be manufactured in the USA. System selection is project-specific. The following underground piping systems are acceptable:
   • Welded steel pipe in tunnel or half tunnel
   • Direct-buried, cement-lined ductile iron
   • Welded steel pipe in insulated FRP conduit
F. Installation Guidelines
1. Piping design must include drains at low points and vents at high points.
2. Install a control valve on each piping riser.
3. Install a drain valve with a 3/4" hose connection and cap at all low points in the system.
4. Ensure that water piping pitches up in the direction of flow.
5. Piping connected to vibrating equipment must have flexible connections to prevent transmitting vibrations through the piping system.
6. Do not install piping in transformer vaults, switchboard rooms, data centers, or telephone rooms, unless absolutely necessary. If necessary, consult with the electrical engineer regarding equipment protection.
7. Do not use mechanical joining components.

G. Quality Control—Testing Methodology and Extent
1. Specify weld inspection and testing that is appropriate for the project.
2. Specify hydrostatic testing at 150 percent of the design pressure. Testing at 150 percent of the working pressure is not acceptable.

H. Cleaning and Adjusting
Cleaning and flushing requirements are per current Northeastern University Facilities group requirements.

-END-
15182

Steam and Condensate Piping

This document provides design standards only, and is not intended for use, in whole or in part, as a specification. Do not copy this information verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of this document to the Northeastern University Project Manager.

A. Summary

This section contains design criteria for steam and steam condensate piping.

B. System Design and Performance Requirements

1. Determine the point of connection to the existing steam distribution system only after conferring with the Northeastern University Facilities group.

2. Any steam used for building heating must be low pressure (5–11 psig).

3. Steam must be supplied to equipment steam control valve inlets at the pressures indicated in Table 1.

<table>
<thead>
<tr>
<th>Table 1. Valve Inlet Pressures</th>
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</thead>
<tbody>
<tr>
<td><strong>Equipment</strong></td>
</tr>
<tr>
<td>Radiators</td>
</tr>
<tr>
<td>Convectors</td>
</tr>
</tbody>
</table>
4. Provide pressure reducing stations as required for each of the following services:
   
   - Radiation and convector heating system reduction must be from 15 psig to 5 psig.
   - Air handling and related equipment (heating coils, steam humidifiers, unit heaters, heat exchangers, water heaters, and kitchen equipment): 5 – 13 psi.
   - Sterilizing and laboratory equipment: Low pressure steam at 15 psi.

5. Size PRV stations for the calculated peak demand for heating and humidification plus equipment (process) load. For equipment load, use 100 percent of the largest single user, plus 25 percent of all other users.

6. Where a single pressure reducing valve size exceeds 4 inches or the turn-down ratio (maximum load/minimum load) is greater than 10, provide two PRVs in parallel, approximately 1/3 plus 2/3 with a single bypass.

7. Where the steam service includes capacity for future expansion, size all components except the PRVs for the future. Size the PRVs for the present load.

8. Provide single a pressure gauge across the PRV with a shutoff cock in both upstream and downstream sensor tubes.

9. Service rooms in which PRV stations are located must be of suitable size to permit easy access for equipment maintenance. If possible, provide two means of egress.
10. Provide identification for each PRV as described in Section 15075: Mechanical Identification.

11. Where feasible, low-side protection must be a pressure-relief valve with the discharge piped to the outdoors. Where such an arrangement is impracticable, use a fail-safe valve that shuts off on high pressure. Where a fail-safe valve is used, it should have a modulating action and should be arranged to throttle in an attempt to maintain a pressure in excess of normal low pressure. Provide a safety limiting valve (SLV) in series with, and upstream of, the PRV. The safety limiting valve must be a line size PRV with an external steam pilot sensing the steam pressure after the PRV. Should the PRV leak, allowing the uncontrolled flow of high-pressure steam into the low-pressure piping, the SLV must close to maintain a preset pressure above the setpoint of the PRV but below the safe working pressure of the downstream steam-consuming equipment. Arrange alarms to indicate that the PRV is not functioning. For example: PRV set to discharge at 8#; HP alarm set for 12#, and fail-safe valve attempts to maintain 15#.

12. Design all pressure reducing stations with a three-valve bypass, using a globe valve in the bypass line.

13. The pilot assembly must contain two sensing diaphragms capable of sensing the reduced, regulated pressure.

14. Because they require little maintenance, solid expansion loops are preferred over mechanical-type devices, which are subject to approval.

15. The minimum steam line size must be 1" for horizontal runs and 3/4" for vertical runs of steam and condensate. Make any necessary size reduction at the equipment.

16. Do not run long, horizontal pipe lines at the floor.

17. Allow 20 percent spare capacity in steam and condensate line sizing.

18. Piping design must include drains at low points and vents at high points.

19. Design piping, hangers, and braces for the seismic zone indicated in Section 00200: Information Available to Designers. The hanger supplier is not responsible for seismic design. The engineer is responsible for the design of anchors, thrust restraints, guides, and similar components.

20. Include pipe marking requirements in the project specifications. Underground systems design must include buried identification and warning tape for damage prevention.
21. For any large steam service, such as the low pressure system for a large building, provide a small, globe-type, warm-up valve, located for convenient operation, to by-pass the main shut-off valve.

22. Design the returns from all pieces of steam-operated equipment to flow by gravity to the return main, flash tank, or pump set. This condition might require trenches in basement floors when pipe space is not provided below basements. Mount hot water generators, converters, and air heating coils high enough to allow gravity condensate flow.

23. Steam condensing equipment using modulating control valves must be float-thermostatic type with an operating pressure range suitable for the maximum steam supply pressure. Trap capacities are must be scheduled on the drawings in pounds of condensate per hour at a one-quarter psi pressure differential across the trap, based on the inlet of the trap being 18 inches below the condensate outlet on the coil. The allowable pressure drop across the trap may be increased correspondingly with increased head provided in the drip leg.

24. Traps on steam line drip points must be inverted-bucket type or fixed orifice, with a bimetallic thermal element for air removal, and with a working pressure range suitable for the maximum line pressure.

25. Do not lift condensate if the system has modulating valves.

C. Submittals
Submit the following design and construction documentation.

1. Designer Submittals
   - Floor plans showing piping
   - Building sections showing piping
   - Isometric diagrams
   - Details
   - Steam and condensate load calculations with sketch

2. Construction Documents
   - Coordinated shop drawings
   - Catalog cuts on piping, valves, traps, unions, strainers, drains, vacuum breakers, and similar components
   - Manufacturer product data and installation instructions
   - Pipe cleaning and pipe pressure test reports.
D. Manufacturers

Manufacturers to be discussed with Northeastern and approved prior to formal print.

E. Materials

1. Pipe and fittings must be manufactured in the USA.
2. Steam pressure reducing valves:
   a. Use self-contained, stainless steel regulators with fluorocarbon compound inserts suitable for steam service.
   b. In all cases, use cast iron valves with ANSI Class 250 body pressure ratings at 450°F.
   c. All valves must be capable of shutting off tight against full primary pressure up to the full body rating.
   d. 2" and smaller valves must have trenched ends. 2-1/2" and larger valves must be 250 flanged.
   e. Actuators must be constructed of cast iron or pressed steel and bolted to the main part of the valves. The use of threaded locknuts is not permitted.

F. Quality Control—Testing Methodology and Extent

1. Specify weld inspection and testing that is appropriate for the project.
2. Specify hydrostatic testing at 150 percent of the design pressure. Testing at 150 percent of the working pressure is not acceptable.

G. Cleaning and Adjusting

Cleaning and flushing requirements are per current Northeastern University Facilities group requirements.
15185

Hydronic Pumps

This document provides design standards only, and is not intended for use, in whole or in part, as a specification. Do not copy this information verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of this document to the Northeastern University Project Manager.

A. Summary

This section contains design criteria for plumbing and HVAC system hydronic pumps.

B. System Design and Performance Requirements

1. Use end-suction pumps for most systems.
2. Use in-line pumps for 100 gpm or less in hot water heating systems.
3. Use double-suction pumps for large-capacity hot water and chilled water systems.
4. Provide pressure gauges for every pump, except small “boosters,” which must have gauge cocks only.
5. Specify that piping and pumps be installed and connections aligned, but not made up, until inspection by Northeastern University. All piping must be supported independently of the pumps.
6. In-line, end-suction and split-case pumps bearing frame and pump internals must be serviceable without disturbing motors or connected piping.
7. Select pumps for an impeller diameter not greater than 90 percent of the maximum pump impeller diameter.
8. Select pump motors to be non-overloading at any point along the pump impeller curve.
9. Select pumps between 65 and 115 percent of best efficiency point along the pump impeller curve.
10. Specify shaft grounding systems when variable-frequency drives are applied.
C. Submittals

Submit the following design, construction, and certification documentation.

1. Designer Submittals
   Submit pump sizing calculations with system sketch.

2. Construction Documents
   Submit the following test reports:
   - Installed pump performance test and balance report.
   - Pump alignment report.

3. Product Certificates Signed by Manufacturer
   Specify that pumps be inspected by the manufacturer's authorized representative who must submit a written report to the engineer with a copy to Northeastern University stating that the pump has been properly installed, is operating correctly, and the installation is acceptable to the manufacturer in every respect.

D. Product Standards

Products must conform to the following standards:
- Hydraulic Institute standards
- ASME PTC 8.2 and 9
- CSA standards
- UL Motor-Operated Water Pumps Standard
E. Manufacturers

Subject to compliance with the design requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. **In-Line Pumps**
   - Bell & Gossett
   - Taco
   - Grundfos

2. **Booster Pumps-Circulator**
   - Bell & Gossett
   - Taco
   - Grundfos

3. **End-Suction Pumps**
   - Bell & Gossett
   - Taco
   - Armstrong

4. **Double-Suction Pumps**
   - Bell & Gossett
   - Taco
   - Armstrong

5. **Vertical-Split and Split-Case Pumps**
   - Bell & Gossett (structural steel base with groutable coupling replacement, without removing motor or pump).
   - Provide pump alignment on a strong base.
   - Provide an integral, variable-frequency drive for all large pumps over 5hp.

6. **Suction Diffuser**
   - Taco
   - Armstrong
F. Materials

1. **Double-Suction Split-Case Pumps**
   a. Double suction pumps must have horizontally- or vertically-split casings.
   b. Materials of construction must be a bronze-fitted pump and must include a cast-iron casing, bronze shaft sleeves, alloy steel shafts, and a bronze-enclosed double-suction impeller. Provide re-greasable ball bearings, replaceable casing wear rings (at all critical clearances between the impeller and volute), drains and vents, flexible coupling, coupling guards, and a steel baseplate. At the manufacturer’s option, a stainless steel shaft with no sleeve may be substituted for the shaft components.
   c. When mounted vertically, split case must be designed for complete servicing without disturbing piping or alignment.
   d. Pump volute must be supplied with plugged vent drain and gauge tappings at suction and discharge ports.
   e. Provide internally-flushed ceramic seal seats and carbon seal rings.
   f. Where a variable-frequency drive (VFD) is used with the pump, provide an elastomer coupling that is compatible with the VFD technology applied to the pump.

2. **End-Suction Pumps**
   a. End-suction pumps must be based mounted, horizontally coupled, with vertically-split cases.
   b. Materials of construction must be for a bronze, fitted pump and must include cast iron casings; bronze shaft sleeves; alloy steel shafts; and bronze, enclosed impellers. Provide regreaseable or permanently-lubricated ball bearings, replaceable casing wear rings (at all critical clearances between the impeller and volute), drains and vents, coupling guards, and a steel base plate.
   c. Pump casings must have vent and drain ports, and must have gauge ports at the suction and discharge nozzles.
   d. The base plate must be structural steel.
   e. Provide a flexible-type coupler and coupling guard.
   f. Where a variable-frequency drive (VFD) is used with the pump, provide an elastomer coupling that is compatible with the VFD technology applied to the pump.
3. **In-Line Pumps**
   a. In-line pumps must have bronze-fitted construction and must include cast iron casings, bronze or copper shaft sleeves, alloy steel shafts, and bronze impellers. Bearings shall be either sleeve-type or re-greaseable ball bearings.
   b. In-line pumps must have a working pressure of 175 psi, a ceramic seal seat, and a carbon seal ring.
   c. Pump casings must have vent and drain ports, and must have gauge ports at the suction and discharge nozzles.
   d. Provide replaceable casing wear rings at all critical clearances between the impeller and volute and between the drain and vent connections. Provide a flexible coupling or direct drive connection between the pump and motor. If the schedule pump includes ball bearings and a direct drive motor-to-impeller connection, the submitted pump must not have sleeve bearings or a flexible coupling between the pump and motor.
   e. Pumps for domestic water applications must be of bronze construction.
   f. Where a variable-frequency drive (VFD) is used with the pump, provide an elastomer coupling that is compatible with the VFD technology applied to the pump.

4. **Pump Motor Drives**
   All pumps over 5 hp must have a variable-frequency drive.

G. **Accessories or Special Features**

1. **Couplings**
   Couplings must be approved by the Northeastern University Facilities group.

2. **Strainers**
   a. For water service, strainers must be the same size as entering pipe size and have a maximum clean pressure drop of one psid.
   b. Use pump startup strainer screens for cleaning, and remove the afterwards.
   c. Provide a blow-off valve on each strainer. Where feasible and permitted by code, blow-off must be piped to the closest drain.

3. **Suction Diffusers**
a. Suction diffusers must have an angle-type body with inlet vanes and a combination diffuser – strainer orifice cylinder. Suction diffusers must also have 200 psi cast-iron body and stainless steel sleeve with 5/32” perforations. Units must include flanged connections, a removable gasketed cover, a permanent magnet, and straightening vanes.

b. Provide a 16-mesh startup strainer.

c. Provide blow-off tapping and a valve on the bottom of the unit.

d. Provide a full-size inlet and outlet.

4. **Triple-Duty Valve**

   a. Triple-duty valves must have a combination non-slam check valve with a loaded-weight, contoured disc. The valves must feature calibrated regulation of pump discharge flow and a positive shut-off.

   b. Valves must be repacked under full line pressure.

   c. The valve must be capable of operating in conditions up to 170 psi and 300°F.

**H. Special Requirements—Source Control**

The manufacturer must maintain an inventory of all wearing parts within 50 miles of Boston, MA.

**I. Installation Guidelines**

1. Provide pump suction fittings on the suction sides of base-mounted, centrifugal pumps.

2. Provide combination pump discharge valves on the discharge sides of base-mounted centrifugal pumps.

3. Support pump fittings with floor-mounted pipe and flange supports.

4. Each pump must be level and re-aligned. Base-mounted pumps must be grouted.

5. Provide a spring-loaded check valve in the pump discharge, in lieu of a swing check valve.

6. All steam and condensate pumps must be vented to the outdoors.

7. All steam and condensate pumps must be fitted with wafer check valves, thermometers, and Y-type strainers.

8. The receivers on condensate pumps must be sized for a minimum of 15 minutes of
9. All duplex pump sets require electric alternators for the two pumps.

J. Quality Control

1. If this portion of the project includes commissioning, verify that insertions in the project specifications have been made that refer to the commissioning procedures in the commissioning specification section. Verify that the systems and equipment identified in this section of the standards and listed in the project specifications do not conflict with commissioning procedures for testing and training.

2. Specify that at least one final alignment be performed in the field.

-END-
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Steam and Condensate Pumps

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A. Summary

This section contains design criteria for steam and condensate pumps.

B. System Design and Performance Requirements

1. All condensate must be returned to the boiler plant by a duplex condensate return pump set discharging into a pumped return line.

2. To reduce condensate temperature to a specified pumping temperature of 200°F, flash tanks must be installed on condensate return lines ahead of the condensate receiver.

3. Size condensate pumps for 2-1/2 to 3 times the amount of condensate returned in one minute.

4. To prevent short-cycling of the pump, size the storage capacity of the receiver to allow a full discharge flow rate for 1-1/2 to 3 minutes.

C. Submittals

Submit pump sizing calculations, with sketch, for condensate return pumps.

D. Product Standards

Products must conform to ANSI/Hydraulic Institute 8.1–8.5.

E. Manufacturers

Subject to compliance with the design requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Condensate Transfer Pumps
   - Hoffman
   - ITT-Domestic
2. **Pressure-powered pumps (liquid movers)**
   - Gestra
   - Johnson
   - Armstrong
   - Spence

**F. Materials**
1. Ensure that a gauge glass is provided with the unit.
2. Use a thermometer and pressure gauge in the discharge line from the unit.

**G. Installation Guidelines**
Design the installation so that the units are accessible for service. If a duplex condensate pump is installed in the pit, locate the starter, disconnect switch, and alternator outside and adjacent to the pump pit.

**H. Quality Control**
If this portion of the project includes commissioning, verify that insertions in the project specifications have been made that refer to the commissioning procedures in the commissioning specification section. Verify that the systems and equipment identified in this section of the standards, and listed in the project specifications, do not conflict with commissioning procedures for testing and training.

-**END**-
15189

HVAC Water Treatment

This document provides design standards only, and is not intended for use, in whole or in part, as a specification. Do not copy this information verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of this document to the Northeastern University Project Manager.

A. Summary
   This section contains HVAC system water treatment design criteria.

B. Submittals
   Submit a water treatment analysis.

C. Installation Guidelines
   1. Install coupon racks for heating, cooling and condenser water systems in an accessible location.
   2. Install chemical shot feeders in areas that are easily accessible and where shot feeders can be washed down.
   4. Clean and flush all water lines before connecting them to the central plant.
   5. Provide backflow preventers on all systems using chemical treatments.
   6. Provide a means of secondary containment for all chemical treatment drums.

D. General
   The contractor shall provide chemicals and labor for the pre-operational cleaning of all condenser, chilled, glycol or hot water and related equipment piping systems. This cleaning method is not intended for potable water systems.
E. Preparation for Clean-Out

All systems must be prepared prior to the introduction of the chemical cleaner.

1. Contractor shall flush all systems, including mud from drop legs. The piping system must be free of mud, silt and construction debris. Remove, clean and replace all strainers. All Systems shall contain city water.

2. Complete circulation must be achieved during the cleaning procedure. A minimum flow rate of 2 ft/sec. needs to be maintained to insure that the cleaning chemicals will work properly. All manual, electrical, air and thermostatic operated valves must be open. All dead end runs must be looped together with piping not less than 1/3 the size of the run. This piping is to remain in place until cleaning is complete.

3. A minimum of 1-1/2” ball or gate valve is to be permanently installed in the low point of each system for the purpose of draining each system.

4. The cleaner shall not require external heat to ensure its effectiveness.

F. Chemicals

The cleaning solution shall be formulated to remove light grease, cutting oils, loose mill scale, organics and extraneous construction debris. The cleaner shall contain inorganic phosphate, an organic corrosion inhibitor, a dispersant, and oil emulsifiers. Enough cleaner should be used to treat all of the piping to remove oil and grease and to permit a uniform passivating film to form.

G. Pre-Operational Cleaning

1. Add chemical directly into the closed loop system before the recirculation pumps to ensure rapid mixing an distribution throughout the system. Refer to MSDS sheets for safety information.

2. For ideal metal passivation, adjust the pH to 6.5. to 7.5 with a small amount of sulfuric acid.

3. Recirculate the system for 16-24 hours.

4. Open and drain mud legs and low points periodically during the cleaning process.

5. Drain systems completely paying particular attention to mud from drop legs and all low points.
6. Refill the system with clean, potable water, check all strainers, recirculate and drain completely.

7. Refill the system again. The length of time between the completion of the cleaning procedure and addition of the corrosion inhibitor shall not exceed twenty-four (24) hours.

8. Add the recommended level of closed loop inhibitor. The system is now ready for operation.

9. Procedure to connect chilled water to the Central Plant chilled water system consists of the following requirements: a) Central Plant personnel must be notified at least two working days before planned start-up. b) Central Plant personnel must observe the system in the clean-up as listed in step one. c) Central Plant personnel must test the water in step 8 for pH and level of corrosion inhibitor. d) Central Plant personnel must test the system for trapped air by opening the manual air vents and checking some drains. e) Central Plant personnel will valve the system to be part of the Central Plant chilled water system.

10. Procedure for all other water and glycol-water mixes is to test the water in step 8 for pH and level of corrosion inhibitor and test the system for trapped air by opening the manual air vents and checking some drains.

11. A service report will be generated on-site by the water treatment representative, certifying that the systems have been cleaned in accordance with the above procedures and shall be copied to the mechanical contractor. A copy of the service report can also be forwarded to the consulting engineer (as requested).

-END-
Fuel Gas Piping

This document provides design standards only, and is not intended for use, in whole or in part, as a specification. Do not copy this information verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of this document to the Northeastern University Project Manager.

A. Summary
   This section contains design criteria for fuel gas systems.

B. Materials
   1. Natural gas.
   3. Malleable steel fittings.

C. Submittals
   Submit the following design and construction documentation.
   1. Designer Submittals
      Submit fuel gas calculations, with pipe sizes and sketch, for each gas-user system.
   2. Construction Documents
      Submit pipe cleaning and pipe pressure test reports.

-END-
General Service Compressed Air Piping

This document provides design standards only, and is not intended for use, in whole or in part, as a specification. Do not copy this information verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of this document to the Northeastern University Project Manager.

A. Summary

This section contains design criteria for non-medical compressed air piping systems and accessories.

B. System Design and Performance Requirements

Design compressed air systems for longevity, durability, and flexibility.

C. Materials

Compressed air—maximum operating limits: 125 psig, 120 °F, copper. Type L wrought fittings only.

D. Submittals

Submit compressed air calculations, with sketch, for compressed air system equipment selection and piping.

E. Quality Control

If this portion of the project includes commissioning, verify that insertions in the project specifications have been made that refer to the commissioning procedures in the commissioning specification section. Verify that the systems and equipment identified in this section of the standards, and listed in the project specifications, do not conflict with commissioning procedures for testing and training.

-END-
15212

Laboratory Air and Vacuum Piping

This document provides design standards only, and is not intended for use, in whole or in part, as a specification. Do not copy this information verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of this document to the Northeastern University Project Manager.

A. Summary

This section contains design criteria for pipe, fittings, and specialties for laboratory air and vacuum systems.

B. System Design and Performance Requirements

1. Design laboratory air and vacuum systems for longevity, durability, and flexibility.

2. Design compressed air and vacuum systems for medical, surgical, dental, and laboratory facilities to be completely independent of each other.

3. Provide a dew point monitor for the compressed air system, and the list the required system dewpoint in the contract documents.

4. All compressed dry air, medical gas piping, and vacuum piping shall be Type L copper. Fittings shall be brazed and purged with inert gas during installation.

C. Submittals

Submit the following design and construction documentation.

1. Designer Submittals
   Submit laboratory air and vacuum calculations, with sketch, for piping and equipment selection.

2. Construction Documents
   Submit pipe cleaning and pipe pressure test reports.
D. Quality Control

If this portion of the project includes commissioning, verify that insertions in the project specifications have been made that refer to the commissioning procedures in the commissioning specification section. Verify that the systems and equipment identified in this section of the standards, and listed in the project specifications, do not conflict with commissioning procedures for testing and training.

-END-
Medical Gas Piping

This document provides design standards only, and is not intended for use, in whole or in part, as a specification. Do not copy this information verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of this document to the Northeastern University Project Manager.

A. Summary
This section contains design criteria for pipe, fittings, and specialties for medical gas piping systems.

B. System Design and Performance Requirements
1. Design laboratory air and vacuum systems for longevity, durability, and flexibility.
2. Design compressed air and vacuum systems for medical, surgical, dental, and laboratory facilities to be completely independent of each other.
3. Provide a dew point monitor for the compressed air system, and list the required system dewpoint in the contract documents.

C. Materials
Medical Air—maximum operating limits: 125 psig, 120 °F copper.

D. Submittals
Submit the following design and construction documentation.

1. Designer Submittals
   a. Submit medical air and vacuum calculations, with sketch, for piping and equipment selection.
   b. Provide dewpoint.

2. Construction Documents
   Submit pipe cleaning and pipe pressure test reports.
E. Quality Control

If this portion of the project includes commissioning, verify that insertions in the project specifications have been made that refer to the commissioning procedures in the commissioning specification section. Verify that the systems and equipment identified in this section of the standards, and listed in the project specifications, do not conflict with commissioning procedures for testing and training.

-END-
15251

General Service Compressed Air Equipment

This document provides design standards only, and is not intended for use, in whole or in part, as a specification. Do not copy this information verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of this document to the Northeastern University Project Manager.

A. Summary

This section contains design criteria for non-medical, general service compressed air equipment, including air dryers.

B. System Design and Performance Requirements

Design compressed air systems for longevity, durability and flexibility.

C. Manufacturers

Subject to compliance with the design requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

- Ingersoll rand
- Scales
- Zerk (Air Dryers)
- Atlas Copco

D. Quality Control

If this portion of the project includes commissioning, verify that insertions in the project specifications have been made that refer to the commissioning procedures in the commissioning specification section. Verify that the systems and equipment identified in this section of the standards, and listed in the project specifications, do not conflict with commissioning procedures for testing and training.

-END-
15252

Laboratory Air and Vacuum Equipment

This document provides design standards only, and is not intended for use, in whole or in part, as a specification. Do not copy this information verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of this document to the Northeastern University Project Manager.

A. Summary

This section contains design criteria for laboratory air and vacuum systems equipment, including air dryers.

B. System Design and Performance Requirements

1. Design laboratory air and vacuum systems for longevity, durability, and flexibility.

2. Vacuum pumps serving laboratories must be duplex package, with receivers, alarms, and control panels. Each pump must be capable of carrying the entire load.

3. Air compressors serving laboratories must be duplex or tripex package, with alarms, desiccant dryers, receivers, and control panels.

4. Design compressed air and vacuum systems for medical, surgical, dental, and laboratory facilities to be completely independent of each other.

C. Quality Control

If this portion of the project includes commissioning, verify that insertions in the project specifications have been made that refer to the commissioning procedures in the commissioning specification section. Verify that the systems and equipment identified in this section of the standards, and listed in the project specifications, do not conflict with commissioning procedures for testing and training.

-END-
Medical Air and Vacuum Equipment

This document provides design standards only, and is not intended for use, in whole or in part, as a specification. Do not copy this information verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of this document to the Northeastern University Project Manager.

A. Summary

This section contains design criteria for medical air and vacuum systems, including compressors, dryers, purification, filters and vacuum pumps, and oral evacuation systems.

B. System Design and Performance Requirements

1. Design laboratory air and vacuum systems for longevity, durability, and flexibility.

2. Vacuum pumps serving medical facilities must be duplex package, with receivers, alarms, and control panels meeting NFPA 99 requirements. Each pump must be capable of carrying the entire load.

3. Air compressors serving laboratories must be duplex or triplex package, with dryers, receivers, alarms, and control panels. Air compressors must meet NFPA 99 requirements.

4. Design compressed air and vacuum systems for medical, surgical, dental, and laboratory facilities to be completely independent of each other.

5. Provide a dew point monitor for the compressed air system, and list the required system dewpoint in the contract documents.

C. Manufacturers

Subject to compliance with the design requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

- ITT Domestic Clinical
- Nash
- Beacon Medical
- Ingersoll-Rand
D. Quality Control

If this portion of the project includes commissioning, verify that insertions in the project specifications have been made that refer to the commissioning procedures in the commissioning specification section. Verify that the systems and equipment identified in this section of the standards, and listed in the project specifications, do not conflict with commissioning procedures for testing and training.

-END-