1 General

1.1. The chilled water distribution system is a central system served by chillers located in the Wade Power Plant and/or the Northwest Chiller Plant.

1.2. Chilled water piping is direct buried in clean sand.

1.3. Operating pressures range from 20 PSIG to 100 PSIG with the norm being approximately 90 PSIG for supply and 75 psig for return.

1.4. Supply water temperature is approximately 45°F and return water temperature is approximately 60°F.

1.5. Materials and installations shall be in accordance with the following industry and association standards.

- ASME B1.20.1 Pipe Threads, General Purpose (Inch)
- ASME B16.5 Pipe Flanges and Flanged Fittings
- ASME B16.9 Factory-Made, Wrought, Butt-Welding Fittings
- ASME B16.11 Forged Fittings, Socket-Welding and Threaded
- ASME B16.21 Nonmetallic Flat Gaskets for Pipe Flanges
- ASME B31.1 Power Piping Code
- ASTM Materials
- AWWA HDPE Pipe Materials
- AWS Welding

1.6. Chilled Water Design Conditions:

1.6.1. 150 PSIG design pressure

1.6.2. 100°F design temperature

1.6.3. 150 PSIG hydrostatic test pressure for a 2-hour duration. Plus or minus 5 PSIG differential.

1.6.4. Water velocities should not exceed 6 feet per second (fps).

1.6.5. New branch lines serving new or existing buildings shall be HDPE pipe.

1.6.6. Where possible, new distribution main line materials shall be HDPE pipe.

1.6.7. Consult Utilities Engineering if an application is believed to be outside of these conditions.

2 Carbon Steel Piping & Components

2.1. Table of materials

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piping</td>
<td>ASTM A53, Grade A or B, Electric Resistance Welded (ERW, Type E), Beveled Ends, Standard Weight (STD) Carbon Steel Pipe. See Note 1</td>
</tr>
<tr>
<td>Fittings</td>
<td>ASME B16.9, ASTM A234-WPB Wrought Carbon Steel, Standard Weight (STD), Butt Weld Fittings See Note 2</td>
</tr>
<tr>
<td>Flanges</td>
<td>ASME B16.5 Class 150, ASTM A105 Forged Steel, Slip On or Weld Neck, Flat Face or Raised Face Flanges. Select weld neck for fitting to fitting</td>
</tr>
<tr>
<td>Bolting</td>
<td>ASTM A307 Grade B, Regular Hex Head, Carbon Steel Bolts and Studs, with ASTM A563 Grade A, Heavy Hex, Carbon Steel Nuts. See Note 3</td>
</tr>
<tr>
<td>Gaskets</td>
<td>ASME B16.21 Gasket to suit ASME B16.5 Flanges</td>
</tr>
<tr>
<td>Branch Connections</td>
<td></td>
</tr>
<tr>
<td>Main ≥2½” to branch ≤2”</td>
<td>Reducing Tee</td>
</tr>
<tr>
<td></td>
<td>Forged Steel Thread-o-lets</td>
</tr>
<tr>
<td>Main ≥2½” to branch &gt;2”</td>
<td>Butt Weld Equal or Reducing Tees</td>
</tr>
<tr>
<td></td>
<td>Nozzle Weld with Reinforcing as Required</td>
</tr>
<tr>
<td></td>
<td>Forged Steel Weld-o-lets</td>
</tr>
</tbody>
</table>

2.2. Coatings

2.2.1. Steel pipe shall be furnished factory-coated with Fusion Bonded Epoxy Coating and then covered with Denso wrap to provide corrosion protection better than just the coated pipe alone.

2.2.2. Coating shall be applied to clean pipe in accordance with manufacturer’s established procedures.

2.2.3. Thickness of coating shall be manufacturer’s standard but not less than 20 mils.

2.2.4. At each end 4” surface shall be left uncoated. After field welding, these uncoated surfaces and all fittings shall be blast cleaned to near white metal, primed with a compatible primer, and brush-painted with a two-part epoxy coating. Covered with Denso wrap system.

2.3. Preferred Manufacturers

2.3.1. Factory-Applied Coatings
2.3.2. Field Brush Applied Coatings
   - 3M Scotchkote 6233
   - DuPont Nap Guard 7-2501

2.3.3. Pipe Wrap System
   2.3.3.1. Field-Applied Primer
    - Denso Paste S105
   2.3.3.2. Field-Applied Mastic
    - Denso Profiling Mastic
    - Denso Mastic
   2.3.3.3. Field-Applied Tape
    - Denso LT Tape
    - Denso Densyl Tape
   2.3.3.4. Field-Applied Protective Overwraps
    - Denso Utility Tape

2.3.4. Alternative coating systems shall require pre-approval of the owner.

2.3.5. Holiday testing for each field-applied epoxy coating may be completed by Owner's Representative prior to burial or installation into direct-bore operations at Owner's discretion. Contact Owner prior to pipe burial for holiday testing to occur. Any defects found shall be remedied by applying Pipe Wrap System as specified in 2.3.3 above, minimum 12" length centered upon the defect.

3 High Density Polyethylene Pipe (HDPE)

3.1. HDPE pipe shall meet the requirements of ASTM D3035, D3350 and/or F714, and AWWA C901 and/or C906.

3.2. HDPE pipe shall be iron pipe size, DR-11 with a working pressure rating of 160 psig at a water temperature of 73°F.

3.2.1. See Note 4

3.3. HDPE pipe size shall be determined for each specific application. HDPE pipe has significantly smaller inside diameter than steel pipe, therefore it is sometimes oversized to achieve the desired inside diameter. However consideration must be given to connecting the larger HDPE pipe to flanges and fittings of steel pipe.

3.4. HDPE fittings shall be selected to provide a working pressure rating of 160 psig. This may require fittings of the next numerically lower size with a thicker wall. Consider the effect of the reduction in inside diameter on fluid velocity and pressure loss if multiple fittings will be required for an installation.

3.5. HDPE pipe shall be limited to nominal 12" diameter without approval from Utilities Engineering.

3.6. HDPE pipe shall be joined by thermal butt-fusion in accordance with the manufacturer's recommendations.

3.7. Transitions from steel to HDPE pipe shall be done with a valve.

3.8. HDPE pipe flange joints shall be made using a flange adapter, which is fused to the HDPE pipe. Epoxy coated steel backup rings shall be fitted behind the flange adapter sealing surface for bolting to the mating flange. Backup rings shall be AWWA C207 Class D for 160 psig.

3.9. HDPE pipe shall have four BLUE horizontal color stripes equally spaced around pipe.

3.10. HDPE pipe shall be laid with a trace wire to facilitate future locating.

3.10.1. Trace wire shall be #12 THHN solid copper.

3.10.2. Trace wire shall be affixed to outside of pipe to resist backfill.

3.10.3. Trace wire color code shall follow piping color code.

3.10.4. Trace wire shall be brought into a building junction box and labeled.

3.10.5. An additional valve box shall be installed at the origin of the HDPE piping run to house both supply and return trace wires. No wire terminations shall be in the valve box, simply coil the trace wire in the box.

4 Installation Guidelines

4.1. Piping

4.1.1. Chilled water piping shall be at least 5 feet below grade at all points but not more than 8 feet.

4.1.2. All buried lines shall be spaced 30" apart, outside of pipe to outside of pipe, with clear side spacing to facilitate future repairs or expansion.

4.1.3. Locate supply piping on the North and/or East side.

4.1.4. Cathodic protection shall be discussed with Utilities Engineering for each project.

4.1.5. Coated steel pipe shall not be lifted with chains. Lifting shall be done with straps that will not damage the epoxy coating. This guideline needs to appear on all drawings that personnel will use for installation.
4.1.6. Coated steel pipe shall not be staged on concrete, gravel or other surfaces that can damage the epoxy coating. This guideline needs to appear on all drawings that personnel will use for installation.

4.1.7. Valved drains shall be installed at all piping low points, and shall be sized to adequately drain the lines with respect to time required. In buildings no buried drains

4.1.8. Valved vents shall be installed at all piping high points, and shall be sized to adequately vent the lines during filling and draining. In buildings, no buried vents.

4.1.9. Unions or flanges shall be installed in all piping connections to equipment, valves, controls, instrumentation and miscellaneous specialties, and whenever necessary to facilitate dismantling of piping and removal of items requiring maintenance and repair.

4.1.10. Branch lines shall take-off at horizontal centerline of main or above. Branch lines shall take-off by means of welded fittings.

4.1.11. The ends of all piping shall be cut square; the faces of all flanges (slip-on, weld-neck, etc.) 1 be at 90 degrees to the longitudinal axis on which they are installed.

4.1.12. Pipe ends shall have all internal and external burrs removed and shall be free of rust, scale, cuttings, debris, and oxide. All pipe ends shall be reamed after threading.

4.2. Flanges

4.2.1. When bolting steel flanges to flat face iron flanges on valve or pump housings use only flat face flanges so the iron housings do not crack when the bolts are torqued.

4.2.2. When flanges are used to connect HDPE pipe to steel or iron pipe or valves, verify bolt pattern and dimensions, and verify that all components will provide a minimum of 150 psig design pressure for the joint.

4.2.3. Flange bolt holes shall straddle horizontal and vertical centerlines, except where noted on the drawings.

<table>
<thead>
<tr>
<th>5 Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 For pipe up to 10&quot; NPS, standard weight pipe is Schedule 40 pipe. For pipe 12&quot; NPS and larger, standard weight pipe has a larger inside diameter (thinner wall) than Schedule 40 pipe. Schedule 40 pipe may be bid as an alternate to standard weight for 12&quot; NPS and larger pipe. Seamless pipe may also be bid as an alternate to electric resistance welded pipe.</td>
</tr>
<tr>
<td>2 ASME B16.9 fittings are rated for pressure and temperature based on the pipe schedule ratings of carbon steel piping. Schedule 40 fittings may be bid as an alternate where allowed for pipe by this guideline. In ASME B31.1, Table A-1, there are two grades of ASTM A234 wrought steel fittings to choose from. Grade WPB has the same tensile and yield strengths as ASTM A53 and A106 Grade B Pipe.</td>
</tr>
<tr>
<td>3 Bolts selected from ASME B16.5 as indicated for Low Strength Bolting, Table 1B. Nuts selected as recommended in ASTM A563 Table X1.1, as referenced in ASTM A307.</td>
</tr>
<tr>
<td>4 Per ASTM D3035 and F714, there are HDPE materials that are capable of a design pressure of 160 psig with a DR-13.5 pipe thickness. DR-13.5 has a larger inside diameter than DR-11, therefore DR-13.5 pipe can be bid as an alternate provided all pipe, fittings and components will be capable of 160 psig design pressure.</td>
</tr>
</tbody>
</table>