Chapter 4

Joints and Connections

4.1 GENERAL REQUIREMENTS

4.1.1 Tightness

Joints and connections in the plumbing system shall be gas tight and watertight for the pressure required by test, with the exceptions of those portions of perforated or open joint piping that are installed for the purpose of collecting and conveying ground or seepage water to the underground storm drains.

Comment: Perforated and open-joint piping is also used for the piping in absorption trenches for private sewage disposal systems. See Section 16.9.5.

4.1.2 Joint Standards

a. Pipe and tube shall be cut 90° or perpendicular to the pipe center lines.
b. The inside diameter of pipe and tube ends shall be reamed, filed, or smoothed to size of bore and all chips removed. All burrs on the outside of the pipe and butt ends shall be removed before the installation.
c. Pipe and tube shall engage into fittings the full manufacturer’s design depth of the fitting socket.
d. Male pipe threads shall be made of sufficient length to ensure the proper engagement.
e. Pipe shall not extend into a fitting or other pipe to such a depth that it will impede or restrict the design flow.
f. Joints made by bonding, welding, brazing, solvent cementing, soldering, burning, fusion or mechanical means shall be free from grease or other substances not specifically required to achieve a satisfactory joint.
g. Pipe sealing or lubricating compound required for threaded pipe joints shall be applied to the male pipe end only and shall be chemically compatible with the pipe and fitting, insoluble, and nontoxic.

Comment: For industry standards for the various joining methods, refer to Table 3.1.3 - Part IV Pipe Joints, Joining Materials, Couplings, Gaskets.

4.1.3 Expansion Joints

Mechanical type expansion joints requiring or permitting adjustment shall be accessible for adjustment and/or replacement.

4.1.4 Increasers and Reducers

Where different sizes of pipes or pipes and fittings are to be connected, increaser and reducer fittings or bushings shall be used. (See Section 2.4.3)
4.2 TYPES OF JOINTS FOR PIPING MATERIALS

4.2.1 Caulked

4.2.1.1 Cast-Iron Soil Pipe

Lead caulked joints for cast-iron hub and spigot soil pipe shall be firmly packed with oakum or hemp and filled with molten lead not less than 1 inch deep and not to extend more than 1/8 inch below the rim of the hub. No paint, varnish, or other coatings shall be permitted on the jointing material until after the joint has been tested and approved. Lead shall be run in one pouring and shall be caulked tight. See Figure 4.2.1.1

![Figure 4.2.1.1](image1.png)

**A LEAD CAULKED JOINT IN CAST IRON SOIL PIPE**

4.2.1.2 Cast-Iron Water Pipe

Lead caulked joints for cast-iron bell and spigot water pipe shall be firmly packed with clean dry jute, or treated paper rope packing. The remaining space in the hub shall be filled with molten lead according to the following schedule:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Depth of Lead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 20 inches</td>
<td>2-1/4 inches</td>
</tr>
<tr>
<td>24, 30, 36 inches</td>
<td>2-1/2 inches</td>
</tr>
<tr>
<td>Larger than 36 inches</td>
<td>3 inches</td>
</tr>
</tbody>
</table>

Lead shall be run in one pouring and shall be caulked tight. See Figure 4.2.1.2

![Figure 4.2.1.2](image2.png)

**A LEAD CAULKED JOINT IN IRON WATER PIPE**
4.2.2 Threaded
The threads in tapered general purpose pipe joints shall conform to ASME B1.20.1. Pipe ends shall be reamed or filed out to the full size of the bore and all chips removed. Thread seal tape, pipe joint compound, or other thread lubricant shall be applied only to the male threads. See Figure 4.2.2

![A Threaded Pipe Joint](image)

**Figure 4.2.2**
**A Threaded Pipe Joint**

4.2.3 Wiped
Joints in lead pipe or fittings, or between lead pipe or fittings and brass or copper pipe, ferrules, solder nipples, or traps, shall be full wiped joints. Wiped joints shall have an exposed surface on each side of a joint not less than 3/4 inch and at least as thick as the material being jointed. Wall or floor flange lead-wiped joints shall be made by using a lead ring or flange placed behind the joints at wall or floor. Joints between lead pipe and cast-iron, steel, or wrought iron shall be made by means of a caulking ferrule, soldering nipple, or bushing. See Figure 4.2.3

![A Wiped Joint on Lead Pipe](image)

**Figure 4.2.3**
**A Wiped Joint on Lead Pipe**

4.2.4 Soldered
a. Soldered joints in copper water piping shall be made using wrought copper pressure fittings complying with ASME B16.22, cast copper alloy pressure fittings complying with ASME B16.18, or cast copper alloy flanges complying with ASME B16.24.

NOTE: Short-cup brazing fittings complying with ASME B16.50 and bearing the mark “BZ” and solder joint fittings with reduced insertion depths for brazing shall not be used where joints are soldered.

b. Soldered joints in copper drain and vent piping shall be made with wrought copper drainage fittings complying with ASME B16.29 or cast copper alloy drainage fittings complying with ASME B16.23.

c. Soldered joints shall be made in accordance with ASTM B828.
d. Solder shall comply with ASTM B32. Flux shall comply with ASTM B813. Flux residue shall be noncorrosive and non-toxic, inside and outside the completed system, after soldering potable water systems, in accordance with ASTM B813.

e. Solder and flux for joints in potable water piping shall contain not more than 0.2% lead.  
   See Figure 4.2.4

Comment: The limit on lead in solder filler metal is to reduce the level of lead in drinking water in accordance with the EPA Safe Drinking Water Act.

Figure 4.2.4
A SOLDERED JOINT

4.2.5 Flared

Flared joints for copper water tube shall be made with fittings complying with ASME B16.26. The tube shall be reamed and then expanded with an approved flaring tool. See Figure 4.2.5

Figure 4.2.5
A FLARED COPPER JOINT

4.2.6 Mechanically Crimped (Pressed) Joints

a. Copper fittings for water supply and distribution, designed for mechanically crimped (pressed) connections to ASTM B88 hard drawn copper water tube, shall include an O-ring gasket complying with NSF 61 for potable water.

EXCEPTION: Mechanically crimped (pressed) joints shall be permitted with annealed copper water tube when such use is included in the fitting manufacturer’s technical data and installation instructions.
b. The fittings shall comply with the material and sizing requirements of ASME B16.22 (wrought copper or copper alloy fittings) or ASME B16.18 (cast copper alloy fittings).

c. During installation, the tube end shall be deburred and depth-marked to permit visual verification of full insertion of the tube into the fitting socket.

d. The joint shall be crimped (pressed) using a tool approved by the manufacturer of the fitting.

e. The joints shall be rated by the manufacturer for not less than 200 psig at 180 deg F.

f. The fittings shall be permitted to be installed in concealed locations.

4.2.7 Push-Fit Joints

a. Fittings for water supply and distribution, designed for manual push-fit connections to copper, CPVC, and/or PEX tubing, shall comply with ASSE 1061.

b. Fittings shall be marked with those tubing materials that they are intended to be used with unless they are suitable for use with all three tubing materials (copper, CPVC, and PEX).

c. Fittings will be installed in accordance with their manufacturer’s instructions

d. During installation, the tube end shall be de-burred and depth-marked to permit visual verification of full insertion of the tube into the fitting socket.

e. The fittings shall be rated by their manufacturer for not less than 125 psig at 180 deg F as listed by ASSE 1061.

f. The fittings shall be permitted to be installed in concealed locations.

4.2.8 Brazed

4.2.8.1 General

a. Brazed joints in copper tubing shall be made in accordance with accepted industry practice. See Appendix L for an accepted practice for general plumbing.

b. Brazed joints in medical gas and vacuum piping shall be made in accordance with NFPA 99.

4.2.8.2 Fittings

a. Fittings in copper tubing with brazed joints shall be wrought solder joint fittings complying with ASME B16.22 or short-cup brazing fittings complying with ASME B16.50. Short-cup brazed joint fittings shall be clearly marked by the manufacturer to differentiate them from solder-joint fittings and avoid their being used in piping with soldered joints.

b. Fittings for medical gas and vacuum piping shall be as required by NFPA 99.

4.2.8.3 Mechanically Formed Tee Branches

a. Mechanically formed tee branches shall be permitted in copper tubing in water distribution systems. The branch connections shall be formed with appropriate tools and joined by brazing. The branch tube end shall be notched and dimpled with two sets of double dimples. The first dimples shall act as depth stops to prevent the branch tube from being inserted beyond the depth of the branch collar. The second dimples shall be 1/4" above the first dimples and provide a visual means of verifying that the branch connection has been properly fitted. The dimples in the branch tube shall be in line with the run of the main. The joints shall be brazed in accordance with Section 4.2.8.1 and ASTM F2014.

b. Mechanically former tee branches shall not be permitted in drain piping.

4.2.9 Cement Mortar

Where permitted as outlined in Section 2.4.4, cement mortar joints shall be made in the following manner:

a. A layer of jute or hemp shall be inserted into the annular joint space and packed tightly to prevent mortar from entering the interior of the pipe or fitting.

b. Not more than 25 percent of the depth of the annular space shall be used for jute or hemp.
c. The remaining depth shall be filled in one continuous operation with a thoroughly mixed mortar composed of one part cement and two parts sand, with only sufficient water to make the mixture workable by hand.

d. Additional mortar of the same composition shall then be applied to form a one-to-one slope with the barrel of the pipe.

e. The bell or hub of the pipe shall be left exposed for inspection.

f. When necessary, the interior of the pipe shall be swabbed to remove any mortar or other material that may have found its way into the pipe.

Comment: Cement mortar joints have been virtually eliminated by the use of alternate joining methods and materials.

4.2.10 Burned Lead (Welded)
Burned (welded) joints shall be made in such a manner that the two or more sections to be joined shall be uniformly fused together into one continuous piece. The thickness of the weld shall be at least as thick as the lead being joined.

Comment: The added welding material must be of the same composition as the lead pipe being joined.

4.2.11 Mechanical (Flexible or Slip Joint)

4.2.11.1 Stainless Steel DWV Systems

a. Joints in stainless steel DWV systems shall be made with an elastomeric O-ring of a material that is suitable for the intended service.

b. Joints between stainless steel drainage systems and other piping materials shall be made with an approved adapter coupling.

4.2.11.2 Cast-Iron Soil Pipe

a. Hubless pipe: Joints for hubless cast-iron soil pipe and fittings shall be made with an approved elastomeric sealing sleeve and corrosion resistant metallic shielded coupling.

b. Hub and Spigot: Joints for hub and spigot cast-iron soil pipe and fittings, designed for use with a compressed gasket, may be made using a compatible compression gasket that is compressed when the spigot is inserted into the hub of the pipe.

See Figures 4.2.11.2-A and 4.2.11.2-B
4.2.11.3 Cast Iron Water Pipe

Mechanical joints in cast-iron water pipe shall be made with a flanged collar, a rubber ring gasket, and the approved number of securing bolts. See Figure 4.2.11.3

4.2.11.4 Clay Pipe

Joints in piping and/or fittings shall be made using flexible compression joints. See Figure 4.2.11.4
4.2.11.5 Concrete Pipe

Flexible joints between lengths of concrete pipe may be made using approved compression type joints or elastomeric materials on the spigot end and in the bell (or hub) end of the pipe. See Figure 4.2.11.5

4.2.11.6 Elastomeric Sleeves

Mechanical joints on drain pipes below ground shall be made with an elastomeric seal conforming to ASTM D3212, CSA B602 or ASTM C1173. Joints shall be installed in accordance with the manufacturer’s instructions.

4.2.12 Ductile Iron Pressure Piping

a. Ductile iron pressure pipe and fittings shall comply with standards listed in Table 3.1.3 and shall be applied and installed in accordance with the manufacturer’s instructions. Joints shall be the push-on type, mechanical type, grooved and shouldered, or flanged. Rubber gaskets shall be suitable for the maximum service temperature.

b. Flexible, unshielded couplings shall not be used for joints in ductile iron pressure piping.

c. With push-on and mechanical joints, spigot ends shall be inserted into bells, as recommended by the manufacturer, rather than bells on to spigot ends.

d. Transitions with plastic or other pressure piping shall be made with transition fittings using push-on or mechanical joints sized for the piping being joined.

4.2.13 Reserved
4.2.14 Plastic

4.2.14.1 General

a. Joints in plastic piping shall be made by one of the following methods where appropriate:
   1. solvent cement
   2. heat fusion
   3. couplings with elastomeric sleeves and corrosion resisting metal screw clamps
   4. approved insert fittings
   5. approved mechanical fittings, or
   6. threads according to approved standards

b. Joints shall be made in accordance with the manufacturer’s instructions for the method used.

See Figures 4.2.14.1-A through-F

4.2.14.2 Solvent Cement Joints in PVC Piping

Primers and solvent cements shall be suitable for joints in PVC piping. Primers shall be purple in color and solvent cements shall not be purple in color.

4.2.14.3 Solvent Cement Joints in CPVC Piping

Primers (where used) and solvent cements shall be suitable for joints in CPVC piping. Primer shall be purple in color and solvent cements shall be orange in color. Primers (where used) shall not be orange in color. Single-step solvent cement used without a primer on piping ½ inch through 2 inch in diameter shall be yellow in color. One step solvent cement used for joining CPVC fire sprinkler pipe shall be listed for fire protection use.

4.2.14.4 UV Detectable Clear Primers

Where a clear primer that is detectable by ultra-violet light is used as a substitute for a colored primer, the installer shall make a UV light detection device available for inspection of the joints for final acceptance.

4.2.14.5 Heat Fusion Joints in PE Water Piping

Heat fusion joints in PE water piping complying with ASTM F714, ASTM D3035, AWWA C901, or AWWA C906 shall be made in accordance with the applicable requirements of ASTM F2620.

4.2.14.6 Threaded Joints in Plastic Piping

Tapered pipe threads for leak-tight joints in thermoplastic pipe and fittings shall comply with ASTM F1498.

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Figure 4.2.14-A
A SOLVENT CEMENT JOINT IN PLASTIC DWV OR WATER PIPING
NOTES

1. Some manufacturers recommend two clamps on each side of the fitting for additional joint strength.

Figure 4.2.14-A

A SOLVENT CEMENT JOINT IN PLASTIC DWV OR WATER PIPING

Figure 4.2.14-B

AN ELASTOMERIC GASKET JOINT FOR UNDERGROUND PLASTIC DWV PIPING

Figure 4.2.14-C

A SHIELDED COUPLING ON PLASTIC DWV PIPING

Figure 4.2.14-D

A SOLVENT CEMENT JOINT IN SOCKET (BELL) END PLASTIC PRESSURE PIPE

b. Joints shall be made in accordance with the manufacturer's instructions for the method used.

See Figures 4.2.14.1-A through-F

4.2.14.2 Solvent Cement Joints in PVC Piping

Primers and solvent cements shall be suitable for joints in PVC piping. Primers shall be purple in color and solvent cements shall not be purple in color.

4.2.14.3 Solvent Cement Joints in CPVC Piping

Primers (where used) and solvent cements shall be suitable for joints in CPVC piping. Primer shall be used where recommended by the manufacturer of the pipe or the fittings, or both. Solvent cements used with primers shall be orange in color. Primers (where used) shall not be orange in color. Single-step solvent cement used without a primer on piping 1/2 inch through 2 inch in diameter shall be yellow in color. Single-step solvent cement used for joining CPVC fire sprinkler pipe shall be rated for fire protection use.

4.2.14.4 UV Detectable Clear Primers

Where a clear primer that is detectable by ultra-violet light is used as a substitute for a colored primer, the installer shall make a UV light detection device available for inspection of the joints for final acceptance.
4.2.15 Slip

Slip joints using washers or approved packing or gasket material, when installed in concealed locations, shall be provided with an access panel. Slip joints using approved ground joint brass compression rings that allow adjustment of tubing but provide a rigid joint when made up, shall not be considered as slip joints that require access. EXCEPTION: Slip joints in tub waste and overflows and their related traps shall not require an access panel. See Figures 4.2.15-A and-B.
4.2.16 Expansion

Expansion joints shall be of approved type and its material shall conform with the type of piping in which it is installed. See Figures 4.2.16-A, 4.2.16-B, and 4.2.16-C
Comment: Expansion joints must to be accessible for adjustment or replacement. Refer to the definition of “accessible”.

Figure 4.2.16-A
AN EXPANSION JOINT FOR PLASTIC DWV PIPING

Figure 4.2.16-B
A MECHANICAL EXPANSION JOINT IN PRESSURE PIPING
4.2.17 Split Couplings

a. Split couplings consisting of two or more parts and a compression gasket, designed for use with grooved or plain end pipe and fittings, shall be permitted to be used for water service piping, hot and cold water distribution piping, storm water piping, and sump pump discharge piping. The complete joint assembly shall be suitable for the intended use and comply with a standard listed in Table 3.1.3.

b. Galvanized steel pipe may be jointed using rolled or cut grooves. Other interior coated pipe shall not be joined using rolled grooves.

See Figure 4.2.17

Figure 4.2.17
A GROOVED PIPE JOINT
4.2.17 Split Couplings

a. Split couplings consisting of two or more parts and a compression gasket, designed for use with grooved or plain end pipe and fittings, shall be permitted to be used for water service piping, hot and cold water distribution piping, storm water piping, and sump pump discharge piping. The complete joint assembly shall be suitable for the intended use and comply with a standard listed in Table 3.1.3.

b. Galvanized steel pipe may be jointed using rolled or cut grooves. Other interior coated pipe shall not be joined using rolled grooves.

See Figure 4.2.17

A GROOVED PIPE JOINT

4.2.18 Butt Fusion

ASTM F714 high-density polyethylene (HDPE) pipe and ASTM D3261 butt fittings shall be joined by butt heat fusion in accordance with ASTM D2657.

4.2.19 Bending

Changes in direction in copper water tube shall be permitted to be made by the use of factory or field bends. Field bends shall be made in accordance with Table 4.2.19. Bends shall be made only with bending equipment and procedures intended for that purpose. Hard drawn tubing shall not be bent with tubing benders intended for only annealed (soft) tube. All bends shall be smooth and free from buckling, cracks, and other evidence of mechanical damage.

<table>
<thead>
<tr>
<th>Nominal Tube Size -in.</th>
<th>Tube Type</th>
<th>Temper</th>
<th>Min. Bend Radius, in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 inch</td>
<td>K,L</td>
<td>Annealed (soft)</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>3/8 inch</td>
<td>K,L</td>
<td>Annealed (soft)</td>
<td>1-1/2&quot;</td>
</tr>
<tr>
<td>3/8 inch</td>
<td>K,L,M</td>
<td>Drawn (hard)</td>
<td>1-3/4&quot;</td>
</tr>
<tr>
<td>1/2 inch</td>
<td>K,L</td>
<td>Annealed (soft)</td>
<td>2-1/4&quot;</td>
</tr>
<tr>
<td>1/2 inch</td>
<td>K,L,M</td>
<td>Drawn (hard)</td>
<td>2-1/2&quot;</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>K,L</td>
<td>Annealed (soft)</td>
<td>3&quot;</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>K,L</td>
<td>Drawn (hard)</td>
<td>3&quot;</td>
</tr>
<tr>
<td>1 inch</td>
<td>K,L</td>
<td>Annealed (soft)</td>
<td>4&quot;</td>
</tr>
<tr>
<td>1-1/4 inches</td>
<td>K,L</td>
<td>Annealed (soft)</td>
<td>9&quot;</td>
</tr>
</tbody>
</table>
4.3 TYPES OF JOINTS BETWEEN DIFFERENT PIPING MATERIALS

4.3.1 Vitrified Clay to Other Material
Joints between vitrified clay and other piping materials shall be made with an approved joint. See Figures 4.3.1-A and 4.3.1-B

![Diagram]

NOTES:
1. The rubber rings must be sized to adapt to the different outside diameters (O.D.) of the different piping materials being joined.
2. There are hundreds of different adapters available for joining different materials, different pipe sizes, and different wall thickness, as well as clay pipe from different manufacturers.

Figure 4.3.1-A
A RUBBER RING TRANSITION JOINT TO VITRIFIED CLAY PIPE

![Diagram]

NOTES:
1. Externally clamped couplings (shielded and unshielded) are a common way of making transition connections from vitrified clay pipe to other piping materials. Various sized gaskets are available to adapt to the different outside diameters (O.D.) of the piping materials being joined.

Figure 4.3.1-B
AN EXTERNALLY CLAMPED TRANSITION COUPLING JOINT TO VITRIFIED CLAY PIPE
4.3.2 Reserved

4.3.3 Reserved

4.3.4 Threaded Pipe to Cast-Iron
Joints between steel or brass and cast-iron pipe shall be either caulked or threaded or shall be made with approved adapter fittings. See Figure 4.3.4

![Figure 4.3.4](image)

A THREADED PIPE TO CAST IRON ADAPTER FITTING

4.3.5 Lead to Cast-Iron or Steel
Joints between lead and cast-iron or steel pipe shall be made by means of wiped joints to a caulking ferrule, soldering nipple, bushing, or by means of a mechanical adapter. See Figure 4.3.5

![Figure 4.3.5](image)

A WIPED LEAD TRANSITION JOINT
4.3.6 Cast-Iron to Copper Tube

Joints between cast-iron and copper tube shall be made by using an approved brass or copper caulking ferrule and by properly soldering the copper tube to the ferrule. See Figure 4.3.6

![Figure 4.3.6](image)

A CAULKING FERRULE FOR CAST IRON TO SWEAT COPPER TRANSITION

4.3.7 Copper Tube to Threaded Pipe Joints

a. Joints from copper tube to threaded pipe shall be made as follows:
   1. DWV Systems: with copper or brass threaded adapters.
   2. Water Systems and Galvanized Steel Pipe: cast brass threaded adapters, dielectric pipe unions conforming to ASSE 1079, dielectric flanges or dielectric waterway fittings that comply with IAPMO PS 66. EXCEPTION: Dielectric pipe unions shall not be installed on connections to water heaters when not recommended by the water heater manufacturer.
   3. To any Non-Ferrous Piping: copper or brass threaded adapter.

b. The adapter fitting shall be connected to the tubing by approved methods, and the threaded section assembled with tapered national pipe threads (NPT).

See Figures 4.3.7-A and 4.3.7-B

![Figure 4.3.7-A](image)

A SWEAT COPPER TO THREADED PIPE TRANSITION
4.3.7 Copper Tube to Threaded Pipe Joints

a. Joints from copper tube to threaded pipe shall be made as follows:

1. DWV Systems: with copper or brass threaded adapters.
2. Water Systems and Galvanized Steel Pipe: cast brass threaded adapters, dielectric pipe unions conforming to ASSE 1079, dielectric flanges or dielectric waterway fittings that comply with IAPMO PS 66.
   
   **EXCEPTION:** Dielectric pipe unions shall not be installed on connections to water heaters when not recommended by the water heater manufacturer.

b. The adapter fitting shall be connected to the tubing by approved methods, and the threaded section assembled with tapered national pipe threads (NPT).

See Figures 4.3.7-A and 4.3.7-B

4.3.8 Special Joints and Couplings for Drain Piping

a. Joints between two different drain piping materials or between different size piping, of the same or different material, shall be made using fittings or mechanical couplings that are designed for the specific application, including adapter fittings, hubless pipe couplings, slip-on couplings, transition couplings, and repair couplings. Installation shall comply with the coupling manufacturer’s instructions and intended use.

b. Shielded couplings shall consist of a flexible elastomeric sealing sleeve, a protecting and supporting continuous metal shield or shear ring, and metal screw clamping bands. All metal parts shall be corrosion resisting. Shielded couplings shall be capable of withstanding a shear test and shall be permitted to partially support the pipe being joined when such installation is recommended by the manufacturer’s instructions.
c. Mechanical unshielded couplings using thermoplastic elastomer gaskets shall consist of a rigid or semi-rigid sealing sleeve and corrosion-resisting metal screw clamping bands. Mechanical unshielded couplings using thermoplastic elastomer gaskets shall not be installed where the operating internal or external temperatures exceed 130°F (54°C) or are below 0°F (-18°C). The pipe shall be supported on both sides of the coupling within 18 inches of the centerline of the coupling. Mechanical unshielded couplings using thermoplastic elastomer gaskets shall not be installed in construction that has a fire rating that restricts the use of flammable materials or be installed in through-penetrations or plenums without additional fire resistance protection.

   EXCEPTION: Mechanical unshielded couplings using thermoplastic elastomer gaskets shall not be used as a joining method for hubless cast-iron soil pipe and fittings.

d. Flexible unshielded couplings shall consist of an elastomeric sealing sleeve and corrosive-resisting metal screw clamping bands. The use of flexible unshielded couplings shall be limited to joints in underground sewer, drain, and vent piping. Where eccentric flexible unshielded couplings are used to maintain the invert of a drain line, the couplings shall align the inverts of the inside walls of the pipes being joined to prevent an obstruction to free flow.

e. The installation of couplings shall comply with the following.

1. Couplings that comply with the following standards may be installed aboveground or underground:
   - ASTM A1056: cast iron couplings for hubless cast iron soil pipe and fittings
   - ASTM C1277: shielded couplings for hubless cast iron soil pipe and fittings
   - ASTM C1461: mechanical couplings with thermoplastic gaskets for DWV piping
   - ASTM C1540: heavy duty shielded couplings for hubless CISP and fittings
   - CISPI 310: cast iron couplings for hubless cast iron soil pipe and fittings
   - FM 1680-Class 1: couplings for hubless cast iron soil pipe and fittings

2. Couplings that comply with the following standard shall only be installed aboveground.
   - ASTM C1460: shielded transition couplings for dissimilar DWV piping

3. Couplings that comply with the following standard shall only be installed underground.
   - ASTM C1173: flexible transition couplings for underground piping

f. Where eccentric flexible unshielded couplings are used to maintain the invert of a drain line, the couplings shall align the inverts of the inside walls of the pipes being joined to prevent an obstruction to free flow.

g. Center stops shall not be required for couplings that join pipes with different inside diameters and for slip-on repair couplings used for repair or rework.

See Figures 4.3.8-A through 4.3.8-D.
NOTES:
1. Rigid unshielded couplings can be used aboveground and underground. They cannot support the pipe. The pipe must be independently supported. Center stops are required except for repair couplings.

Figure 4.3.8-A
A SHIELDED COUPLING ON DRAINAGE PIPING

NOTES:
1. Shielded couplings can be used aboveground and underground. They can partially support the pipe. Center stops are required except for repair couplings.

Figure 4.3.8-B
A RIGID UNSHIELDED COUPLING ON DRAINAGE PIPING

Figure 4.3.8-C
A TRANSITION CONNECTION USING A SHIELDED COUPLING
NOTES:
1. Flexible unshielded couplings are limited to underground sewer, drain, and vent piping. The couplings cannot support the pipe. The piping must be properly backfilled to avoid stresses on the couplings.

Figure 4.3.8-D
A TRANSITION CONNECTION USING A FLEXIBLE UNSHIELDED COUPLING

4.3.9 Plastic DWV Pipe to Other Materials

a. Joints between plastic DWV pipe and piping of other materials shall be made in accordance with the manufacturer’s instructions for the pipe and fittings unless prohibited by this Code.

b. Threaded Joints: Threaded joints for connecting plastic drain piping to other materials shall be made with proper male or female threaded plastic adapters. Joints shall not be over-tightened. After hand tightening, one-half to one full turn shall be made with a strap wrench. See Figure 4.3.9-A

c. Solid Wall PVC Schedule 40 DWV Plastic Pipe to Cast-Iron Hub Ends: Joints shall be made by caulking the plastic pipe into the hub end with molten lead and oakum or by use of a compression gasket that is compressed when the plastic pipe is inserted into the hub end. Joints shall be permitted to be made with or without a hub end plastic adapter. Adapters without a caulking bead shall be permitted. See Figures 4.3.9-B through 4.3.9-D

d. Cellular Core PVC Schedule 40 DWV Plastic Pipe to Cast-Iron Hub Ends: Joints shall be made by caulking a solid plastic adapter into the cast-iron hub end with molten lead and oakum or by use of a compression gasket that is compressed when the plastic pipe is inserted into the hub end. Adapters without a caulking bead shall be permitted. Cellular core plastic pipe shall not be lead caulked.

e. Plastic Pipe to Galvanized Steel, Copper or Stainless Steel DWV Tube, or Cast-iron Spigot Ends: Joints between plastic pipe and the listed materials shall be made with proper transition fittings.

f. ABS and PVC Plastic Pipe: Solvent cemented non-pressure joints between ABS and PVC DWV piping systems shall be made with an ASTM D3138 solvent cement intended for such transition joints. Transition cement shall not be permitted to be used within buildings. Transition joints shall be a minimum of 3 feet outside of buildings.
NOTES:
1. Plastic pipe that is lead caulked must be solid plastic. Molten lead will melt cellular core plastic pipe.

Figure 4.3.9-B
A LEAD CAULKED JOINT FOR PLASTIC DWV TO CAST IRON HUB
Figure 4.3.9-C
A COMPRESSION GASKETED JOINT FOR PLASTIC DWV TO CAST IRON HUB

NOTES:
1. Plastic pipes that are lead caulked must be solid plastic. Molten lead will melt cellular core pipe.

Figure 4.3.9-D
A LEAD CAULKED PLASTIC SOCKET JOINT TO CAST IRON PIPE
4.4 CONNECTIONS BETWEEN DRAIN PIPING AND CERTAIN FIXTURES
   a. Connections between drain piping and floor outlet plumbing fixtures shall be made by means of an approved
      flange that is attached to the drain piping in accordance with the provisions of this chapter. The floor flange shall
      be set on and securely anchored to the building structure.
   b. Connections between drain piping and wall hung water closets shall be made by means of an approved
      extension nipple or horn adapter.
   c. Connections shall be bolted to the flange or carrier using corrosion resisting bolts or screws, or assemblies
      recommended by the manufacturer.

4.5 WATERPROOFING OF OPENINGS
   a. Joints around vent pipes at the roof shall be made watertight by the use of lead, copper, aluminum, plastic, or
      other approved flashing or flashing materials. See Section 12.4.7.
   b. Exterior wall openings shall be made watertight.

4.6 JOINTS IN LARGE SIZE CAST IRON SOIL PIPE
Cast-iron soil pipe and fittings (hub & spigot and hubless) five inches and larger shall be braced to prevent
horizontal and vertical movement. Support shall be provided at every branch connection and change of direction
by the use of braces, blocks, rodding, or other effective method to prevent movement and joint separation.