7. Allowable Fittings.

a. General Requirements.

1) The fittings listed in this section are generally the allowable fittings for the design of DIP and PVC pipe. For steel pipe and fittings, see Part One, Sections 2 (Pipe Material and Fittings) and 3 (Pipe and Fitting Joints).

b. Design Considerations.

1) DIP.

a) Allowable fittings can be either AWWA C110 (full size fittings) or AWWA C153 (compact fittings). The lay lengths are different between the two AWWA standards. Determine if space requirements will limit the design to either AWWA C110 or C153 fittings.

b) Compact fittings in accordance with AWWA C153. The lay lengths for these fittings are in accordance with AWWA C153, which only provides a minimum lay length for each fitting. Use the minimum lay length of the fitting, as specified in AWWA C153 and provide a means to adjust to the manufacturer's lay length in the design.

c) Fittings for 54-inch DIP.

(1) Lay lengths for these fittings are in accordance with AWWA C153, which only provides a minimum lay length for each fitting. Use the minimum lay length of the fitting, as specified in AWWA C153 and provide a means to adjust to the manufacturer's lay length in the design.

(2) Mechanical joints are not available on fittings for 54-inch DIP, see Part One, Section 3 (Pipe Material and Fittings). Therefore, connections to field cut restrained joint 54-inch DIP can not be accomplished with a mechanical joint solid sleeve. Special attention will be required for the design in order to avoid the need for connecting to field-cut 54-inch restrained joint DIP pipe or provide some other means for closures (field welding of the retainers is not permitted).

d) ANSI B/16.1, Class 250 Flanges on Fittings.

(1) Specify ANSI B16.1, Class 250 flanged fittings when they will be connected to a Class 250 Gate Valve, see requirements under Part One, Section 19 (Pipeline Valves). During the design, if possible try to use a transition short piece of DIP (ANSI B16.1, Class 250 flat face flange by AWWA C110 flange).

(2) ANSI B16.1, Class 250 flanged fittings may not be available. Verify availability with the manufacturer during the design. ANSI B16.1, Class 250 requirements for lay lengths, which are different than AWWA C110 requirements. The design must incorporate the lay length that will allow all manufacturers to supply the fittings.

2) PVC Pipe.

a) Allowable fittings for PVC pipelines.

(1) Injection-molded fittings in accordance with AWWA C907 for sizes 4-inch through 8-inch.

(2) Fabricated fittings in accordance with AWWA C900, Class 200 or AWWA C905, Class 235.

(3) Ductile Iron fittings as specified in this section.

b) For design, use Ductile Iron Fitting.

c. Type of Fittings

1) **Bends.**

a) Minimize the use of bends and attempt to align the pipeline by deflecting pipe joints, see Part One, Section 12 (Allowable Joint Deflections). Deflecting the joints on bends is not permitted, see Part One, Section 14 (Joint Deflection at Fittings), unless thrust restraint design calculations for the bend for additional joint deflections are submitted in accordance with Part Three, Section 27 (Thrust Restraint Design For Buried Piping).

b) Allowable bends

(1) For Ductile Iron Fittings, 1/4$^{th.}$ or 90^{o}, 1/8$^{th.}$ or 45^{o}, 1/16 $^{th.}$ or 22-1/2^{o} and 1/32$^{nd.}$ or 11-1/4^{o}. Use of 1/4$^{th.}$ or 90^{o} bends in the horizontal plane only upon approval. Use of 1/4$^{th.}$ or 90^{o} bends is not permitted in the vertical plane.

(2) For PVC bends, design using ductile iron fittings. PVC fittings may not be available.

c) Bends can be used in the horizontal or vertical plane.

(1) Horizontal plane bends are referred to as horizontal bends (HB).

(2) Vertical plane bends are referred to as Upper Vertical Bend (UVB), where the thrust force is transferred upward to top of pipe and Lower Vertical Bend (LVB), where the thrust force is transferred downward to invert of pipe.

d) Thrust blocking for bends greater than 16-inch in diameter is not covered by the Standard Details and requires special design, see Part Three, Section 27 (Thrust Restraint Design For Buried Piping).

e) Bends designed to be rotated in both the horizontal and vertical plane require special pipe restraint, see Part One, Sections 13 (Rotation of Fittings), 14 (Joint Deflections at Fittings) and 15 (Deflections of Pipe Joints) and Part Three, Section 27 (Thrust Restraint Design For Buried Piping).

2) **Tees.**

a) The connecting branch pipe must be perpendicular or ninety (90^{o}) degrees to the mainline pipe. No joint deflections are allowed at the branch connection of the tee.

b) For PVC tees, design using ductile iron fittings. PVC fittings may not be available.

c) If the mainline DIP is 24-inch or larger and it is noted on the drawings, a welded-on connection 8-inch and smaller may be designed in lieu of a tee, see Welded-on Connections, in this section.

d) Use a TS&V when connecting to an existing main having more than ten (10) domestic services that would be placed out of service during the installation of a tee. Exceptions may be granted, if no other alignments are feasible.

e) Thrust blocking for branch sizes larger than 16-inch diameter is not covered by Standard Details and requires special thrust restraint design, see Part Three, Section 27 (Thrust Restraint Design For Buried Piping).

f) Tees designed to be rotated greater than five (5^{o}) degrees in the vertical plane may require special pipe restraint, see Part Three, Section 27 (Thrust Restraint Design For Buried Piping) and Design Requirements for Pipeline Valves under Part One, Section 18 (Pipeline Valves).

3) **Cross.**

a) The alignment requires two connecting pipelines to cross the main pipeline perpendicular to each other.

b) For PVC cross, design using ductile iron fittings. PVC fittings may not be available.

c) Welded-on connections and TS&V cannot be used in lieu of crosses, unless the connections are spaced far enough apart. See requirements for Welded-on Connections and TS&V, in this section.

d) The branch connections of the cross must be extended for a distance on both sides of the cross, see Table "28" (Length of Straight Pipe Required in Front of Valves) in Part Three, Section 27 (Thrust Restraint Design For Buried Piping).

(1) If the branch connections are not extended for the distance noted above, use two (2) tees.

(a) Example: If one side of the cross is not extended, the cross will act similar to a tee and will require thrust blocking. When the pipeline is extended in the future, removing the blocking behind the tee, a total water system shutdown would be required due to removal of the blocking and the plug.

(b) If the design requires connections on both sides of the pipeline and a cross cannot be used, provide a minimum of ten (10) feet spacing between the centerline tees.

e) If the alignment from the cross requires using one or more reducers on one or both sides of the cross, special pipe restraints are needed for any unbalanced forces due to the reducer, see Part Three, Section 27 (Thrust Restraint Design For Buried Piping).

4) **Tapping, Sleeve and Valve (TS&V).**

a) Design TS&V for only DIP, CIP and PVC pipe. Indicate on the drawings the type of existing pipe to be tapped. This information is provided from the as-built drawings and/or WSSC's contract files.

b) When designing a connection to an existing CIP water pipeline, research the original contract documents, or verify with WSSC to determine the type and outside diameter of the existing pipeline.

(1) Older CIP (Pit Cast Iron Pipe and Centrifugally Cast Iron Pipe) that was manufactured prior to and into the 1950's can have an outside diameter (OD) that is equal to or greater than the OD of CIP or DIP produced from the 1960's to the present.

(2) As-built drawings and contract files can be checked to ascertain the existing pipe class or wall thickness, so that a compatible tapping sleeve and gasket can be identified and incorporated into the contract documents.

(3) If the class or thickness of the pipeline cannot be determined or if a suitable tapping sleeve and gasket combination cannot be identified, the design must provide for one of the following:

(a) Test pits will be required on the existing pipeline for determining the pipe OD.

(b) Design the connection using a tee, in lieu of a TS&V.

(c) Also, require the contractor to test pit for determining the pipe OD and provide the suitable tapping sleeve.

c) When the connection to the existing pipe is 12-inch and larger DIP or CIP and the connecting pipe is 6-inch and larger, design the connection to the existing pipeline using a TS&V. Exceptions will be reviewed by WSSC.

d) Use a TS&V when connecting to an existing main, having more than ten (10) domestic services that would be placed out of service during the installation of a tee. Exceptions may be granted by the WSSC, if no other alignments are feasible.

e) Pipeline being tapped may be the same size as the branch pipe, unless the proposed main is larger than 14-inch, see the requirements for valve sizing in Part One, Section 19 (Pipeline Valves).

f) Design the location of the tapping sleeve on DIP or CIP, so that the centerline of the connecting pipeline is a minimum of five (5) feet from the face of any existing bell joints.

g) Design no more than one TS&V on the same existing nominal pipe length.

h) Verify that adequate space is available to avoid conflict between existing utilities and the tapping machine. Check with the tapping machine manufacturers for space requirements.

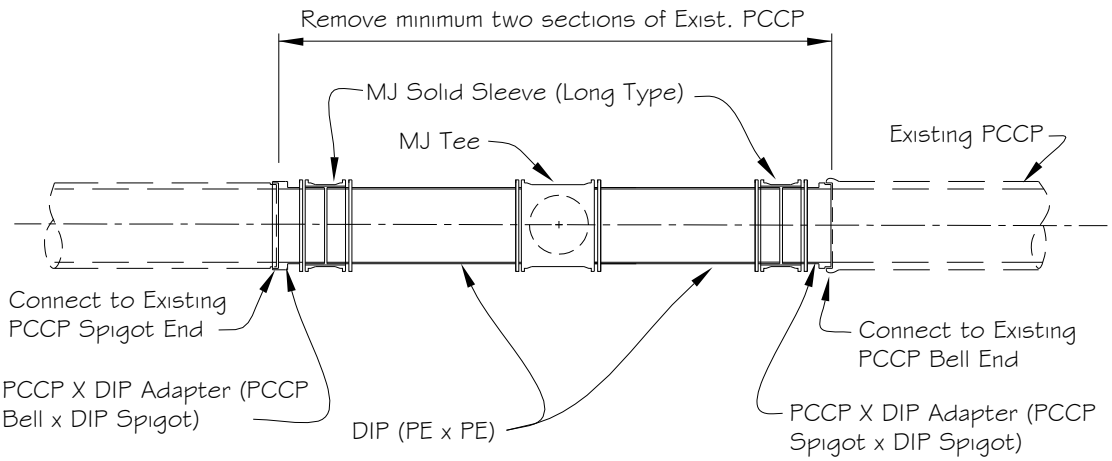
i) Restrain or block the TS&V's in the same manner as a tee.

j) For additional requirements, see Tees in this section.

5) **Tapping Assembly and Valve (TA&V).**

a) Tapping Assembly and Valve (TA&V) is not allowed for connecting to existing PCCP water mains.

b) For connecting to existing PCCP water mains, see Sketch “A”.



SKETCH "A"

Connecting to Prestressed Concrete Cylinder Pipe Using a Tee

c) Show the manufacturer's name and job number for the existing PCCP pipeline on the drawings for example, Lockjoint # PE-00-00. This information can be obtained from WSSC.

6) Welded-on Connections.

a) Welded-on connections may be used in lieu of tees on DIP for blowoffs, air valves and branch connections, if the mainline pipe is 24-inch diameter or larger and the welded-on connection is a minimum of 3-inch diameter up to a maximum of 8-inch in diameter. For additional requirements, see Tees, in this section.

b) In accordance with the Specifications, there are two types of Welded-on Connections:

(1) Welded-on Bosses

(a) This type of outlet has the socket welded onto the mainline pipe. When a flanged valve is required to connect to the flanged welded-on boss, a short piece of flanged by flanged DIP will be required.

(2) Welded-on Outlets

(a) This type of outlet has a short length of DIP welded onto the mainline pipe.

c) In accordance with the Specifications, welded-on connections require a minimum Class 54 DIP for the mainline pipe. Restrain or block the welded-on connections in the same manner as a tee.

d) Provide a note on the plan and profile indicating the location of the welded-on connection and type of outlet joint connection.

e) Pipe joints for welded-on connections shall be as follows:

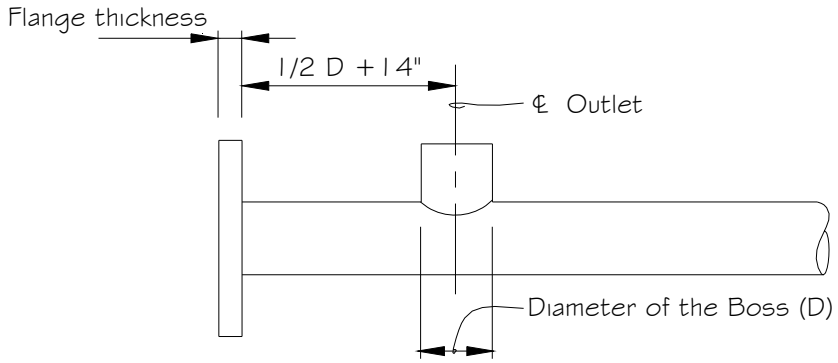
(1) Flanged as specified in AWWA C-110 or ANSI B16.1 Class 250, when in a vault.

(2) Mechanical joint or push-on restrained joint bell, when buried.

f) Locate welded-on connections on the mainline pipe as follows:

(1) Welded-on Connections on Flanged Pipe

(a) The centerline of the outlet must be a minimum of one-half (1/2) the outlet diameter plus 14-inch from the inside edge of the flange, see Sketch "B".

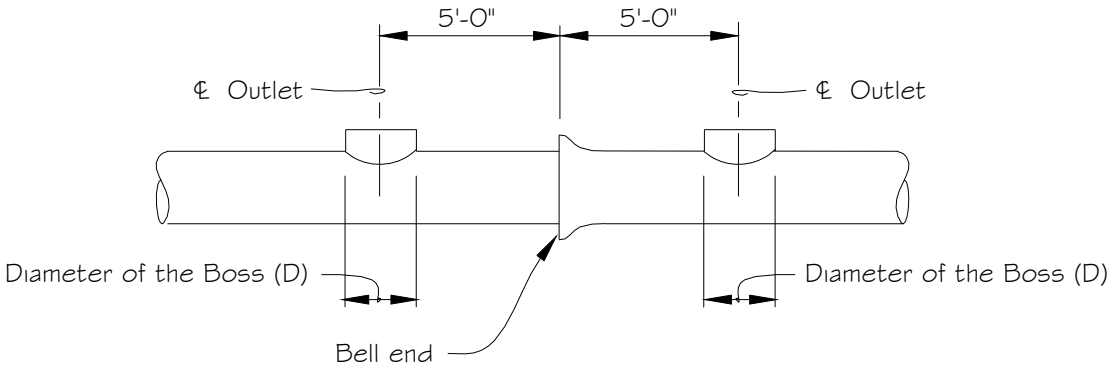


SKETCH "B"

Location of Welded-on Connection, Flanged Pipe

(2) Welded-on Connections on pipe other than flanged pipe

(a) The centerline of the outlet must be a minimum of five (5) feet from the bell face of the mainline pipe, see Sketch "C".



SKETCH "C"

Location of Welded-on Connection, Pipe Other Than Flanged Pipe

7) **Plugs and Caps.**

a) Plugs and caps are to be used at the end of pipelines and branch connections. The Contractor has the option to use either a plug or cap.

b) On the drawings specify a cap.

c) Thrust blocking for plugs and caps larger than 16-inch diameter is not covered by the Standard Details and requires special thrust restraint design; see Part Three, Section 27 (Thrust Restraint Design for Buried Piping).

8) **Wyes.**

a) Wyes are not permitted for use on water pipelines, except when the design requires flanged end fittings inside structures.

9) **Reducers.**

a) Required when downsizing the pipeline; may require special thrust restraint for unbalanced forces, see Part Three, Section 27 (Thrust Restraint Design for Buried Piping).

b) Avoid using reducers on short runs of pipe if the cost of downsizing the pipeline, which includes pipe restraints for reducer, house connection taps with saddles, a reducer, etc., exceeds the cost of the larger diameter pipeline.

c) When reducing the pipe size on 16-inch and larger pipelines, the profile must be examined to determine if the reducer will create a high point at the large end of the reducer. If so, use an eccentric reducer, matching the top elevations of both size pipelines at the reducer.

10) **Adapters.**

a) When connecting to or extending PCCP pipelines, a PCCP by DIP adapter is required, see Specifications for requirements of PCCP adapter.

b) Typically, the DIP end of the adapter will require a flanged end, see Standard Details C/3.3 and C/3.4, and Part Three, Section 28 (Corrosion Control). When a PVC spool piece is used the DIP end of the adapter will require a mechanical joint bell, see Standard Detail C/3.3a and Part Two, Section 3 (Pipe and Fitting Joints).

c) Design the connection between PCCP and DIP to account for unbalanced thrusts. For requirements see Unbalanced Thrusts at Connections to Existing Water Pipelines under Part Three, Section 27 (Thrust Restraint Design for Buried Piping).

11) **Solid Sleeves and Mechanical Couplings.**

a) Generally, mechanical joint solid sleeves are used for direct burial conditions and mechanical couplings are used in vaults and structures.

b) Type of DI mechanical joint solid sleeves is as follows:

(1) Mechanical Joint, Long Type

(a) Use this type of sleeve only for single closures between the ends of the pipeline.
(b) Typically this type of sleeve requires a spacer piece, see Standard detail W/11.0, for long type solid sleeves.

(2) Mechanical Joint, Short Type can be use as follows:

(a) Use two closures between the ends of the pipeline (which eliminates the need for a spacer piece), see Standard detail W/11.0.

(b) This type of sleeve may be an acceptable alternative to using a restrained mechanical coupling in a vault, in accordance with Standard Detail B/3.0, except the joints must be restrained with a wedge action restraining gland, see Standard Detail W/2.4 for an example.

(c) When using this fitting on situations other than those described above, approval will be required.

(d) Some manufacturers may not supply short type solid sleeves. The Designer must verify the availability of this fitting during the design.

(2) Solid Sleeve for 54-inch DIP.

(a) This type of sleeve is not available. During the design phase determine and verify the type of sleeve/coupling that will be required. See "Design Considerations" in this section for information on 54-inch diameter fittings.

d) Types of mechanical couplings.

(1) Mechanical Couplings.

(a) Mechanical Couplings are used for connecting pipelines in vaults and structures where the pipelines have the same OD.

(b) Direct burial of mechanical couplings requires approval and special exterior coatings, see Part Three, Section 28 (Corrosion Control).

(c) Mechanical coupling may require restraint; see Standard Detail B/3.0.

(d) When the design requires a mechanical coupling to be connected next to a flanged gate valve, provide a flanged spool piece a minimum of 12-inches long between the flanged end of the valve and the flanged end of the assembly for harnessing the coupling, see Standard Detail B/3.0.

(2) Transition Couplings.

(a) Transition Couplings are use for connecting pipelines with different OD's. Verify OD's of the connecting pipes before specifying this type of coupling, or provide requirements in the contract documents for the contractor to verify the OD's.

(b) For connecting to Existing Asbestos Cement Pipe (ACP), see Standard Detail W/11.1.

(c) Transition Couplings may be used for direct burial with approval and require special exterior coatings, see Part Three, Section 28 (Corrosion Control).

(3) Insulating Couplings.

(a) Insulating Couplings provide electrical isolation for metallic pipelines; see Part Three, Section 28 (Corrosion Control).

(b) Direct burial of insulating couplings requires WSSC approval and special exterior coatings, see Part Three, Section 28 (Corrosion Control).

(c) Use of insulating couplings requires special insulating thrust restraint if used on a restrained length of pipe.

12) **Offsets.**

a) Offsets may be used in lieu of two bends when approved.

b) The allowable offset diameter and offset distance "D" dimension are as follows:

(1) Offsets are limited to sizes 12-inches and smaller diameter fitting size (diameter of pipe).

(2) Offset distance "D" dimension can only be 6, 12 or 18-inches.

c) Provide special thrust restraint for the offset, see Part Three, Section 27 (Thrust Restraint Design for Buried Piping).

13) **Other Fittings.**

a) The allowable fittings listed in this section are the only fittings approved for design. Fitting manufacturers can produce non-AWWA standard fittings (AWWA C110, C153, C900, C905 and C907) which are not approved by WSSC. These fittings may be used in the design only with WSSC approval and require special provisions to the Specifications.