

Pipe Joints – General Information

The purpose of this ePipe document is to provide a listing of the different pipe joint types and requirements of the different pipe materials in one location as a reference. It is intended to serve as a guide to distinguish and compare joint types when considering service requirements. This guide includes the appropriate reference specifications for further review, if required.



Concrete Pipe Joints

ASTM C76 – Not intended to be used to specify joint performance (pipe manufacturing spec)
“Joints designed such that pipe sections form a continuous line.”; but it does specify some manufacturing requirement for joints as shown below:

- If non-rubber gasket:
 - o Pipe Diameter smaller than 36” requires no reinforcing steel in the joints.
 - o Pipe Diameters 36” and larger requires reinforcing in either the spigot or the bell.
 - o The maximum end cover is ½ of joint length or 3” whichever is less.
- If Rubber Gasket Joint:
 - o Pipe Diameters 12” and larger requires the bells to have reinforcing steel.
 - o The maximum end cover of last circumferential is 2”

ASTM C990 – Joints sealed with preformed flexible joint sealant (joint spec)

Joint under this specification are “Not intended for operation under internal pressure or subject to measurable infiltration & exfiltration limits”

- For horizontal pipe, the requirements of this spec are intended to prevent flow of solids through the joint
- Plant test – 10 psi for 10 min. (QC test only, not intended for service conditions.)

ASTM C443 – Flexible watertight joints using rubber gaskets when infiltration or exfiltration is a factor in design (joint spec)

- Joints will perform with up to 13 psi (30 ft head) w/o leakage in a plant / lab test
- When required by owner: performance test –
 - o Straight alignment: 13 psi for 10 min.
 - o Deflected (½” joint gap on one side): 10 psi for 10 min.



ASTM C1628 – Flexible leak resistant joints for gravity flow sewer pipe using rubber gaskets when measurable or defined infiltration or exfiltration is a factor (joint spec)

- Joints will perform with up to 13 psi (30 ft head) w/o leakage in a plant / lab test
- In-Plant Performance tests
 - Straight alignment: 13 psi for 10 min.
 - Deflected ($\frac{1}{2}$ " joint gap on one side): 10 psi for 10 min.
 - Joint shear test (per C497) strength test

ASTM C361 – Low head pressure installations (spec covers design of pipe and joints)

Pipe designed for various hydrostatic heads measured to the centerline of the pipe using rubber gasket joints

- 25 ft head (10.8 psi)
- 50 ft head (21.7 psi)
- 75 ft head (32.5 psi)
- 100 ft head (43.3 psi)
- 125 ft head (54.2 psi)
- Plant test required at 20% over design pressure
 - Straight alignment
 - While loaded in shear causing maximum annular space (150 lb / inch diameter)

High Density Polyethylene (HDPE)

ASTM F2306 – sets three levels of joint performance:

- Soil tight
- Silt tight
- Water tight

Soil tight: Function of opening size, channel length and backfill particle size

- Refers to AASHTO Construction Section 26 (Metal Pipe) for further explanation
- Section 26 allows openings up to 1.0"
- If opening is more than 0.125" then the channel (length of opening) shall be at least 4 times the size of the opening.
- There is a warning given about using soil tight with backfill materials containing a lot of fines

Silt tight: Joint using bell and spigot with a gasket, meeting test of ASTM D3212 except reduced pressure to 2.0 psi.

- Straight alignment 2 psi (4.6 ft head) internal hydrostatic & vacuum
- Deflected joint laterally to manufacturer's stated limit and retest – same criteria
- Load pipe at distance $\frac{1}{2}$ pipe diameter from the joint to 5% deflection from round and retest – same criteria
- Note that these tests do not simulate the installed, fully loaded and deflected (oval) state of the pipe joint that will occur in the field.

Water tight: Joint meeting a 10.8 psi laboratory test in accordance with ASTM D3212.

- Straight alignment 10.8 psi (25 ft head) internal hydrostatic & vacuum



An educational document from the American Concrete Pipe Association for users and specifiers

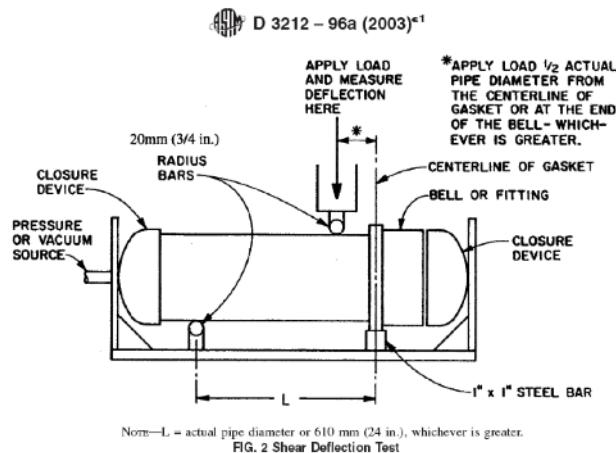
- Deflected joint laterally to manufacturer’s stated limit and retest – same criteria
- Load pipe at distance ½ pipe diameter from the joint to 5% deflection from round and retest – same criteria
- Note that these tests do not simulate the installed, fully loaded and deflected (oval) state of the pipe joint that will occur in the field.

Steel Ribbed Polyethylene (SRPE)

ASTM F2562 – sets same three performance levels as HDPE, above

Manufacturer’s literature: states the following four levels of performance for corresponding joints:

- *Soil Tight (“ST”) Joints* – 30” through 96” plain/cut ends, using flat or dimpled steel bands with flat elastomeric gaskets (typically requires geotextile wrap to limit fill infiltration)
- *Low Head (“LH”) Joints* – 30” through 72” bell and spigot ends with elastomeric gaskets, lab tested to 3 psi per ASTM D3212
- *High Performance (“HP”) Joints* – 30” through 72” steel reinforced bell and spigot ends with elastomeric gaskets, lab tested to 15 psi per ASTM D3212
- *Welded Coupler (“WC”) Joints* – 36” through 120” plain/cut ends field-welded together with an internal polyethylene coupler by electrofusion or extrusion welding, and lab tested to 30 psi per ASTM D3212 (typically requires geotextile wrap to limit amount of internal surface cleaning required for adequate welding)



Polypropylene (PP)

Sanitary PP 12 inch to 30 inch (300mm to 750mm) Double Wall

ASTM F2736

- Smooth interior and annular exterior corrugations
- Pipe stiffness of 46psi in accordance with testing procedure ASTM D2412

- Pipe joined with gasketed integral bell and spigot

ASTM D3212

- Joint must meet a 10.8psi laboratory test.
- Spigot has two gaskets meeting requirements of ASTM F477

ASTM F1417

Low pressure 3.5 psi air test

ASTM F2487

Infiltration/exfiltration test for watertightness (50-200 gallons/inch/mile/day)

ASTM F477

Bell & Spigot connections have a spun-on, welded or integral bell and spigot with gaskets

Sanitary PP 30 inch to 60 inch (750mm to 1500mm) Triple Wall

ASTM 2764

30 inch through 60 inch (750 mm to 1500 mm) has an interior wall, an exterior wall and an annular corrugated profile middle wall

ASTM D3212

- Joint must meet a 10.8psi laboratory test.
- Spigot has two gaskets meeting requirements of ASTM F477

ASTM F1417

Low pressure 3.5 psi air test

ASTM F2487

Infiltration/exfiltration test for watertightness (50-200 gallons/inch/mile/day)

ASTM F477

Bell & Spigot connections have a spun-on, welded or integral bell and spigot with gaskets



PP Storm 12 inch to 60 inch (300mm to 1500mm)(Double Wall and Triple Wall)

ASTM F2736

12 inch through 30 inch (300mm to 750mm) has a smooth interior and annular exterior corrugations

ASTM F2881

30 inch through 60 inch (750mm to 1500mm) has a smooth interior and annular exterior corrugations

AASHTO M330

12 inch through 60 inch (300mm to 1500mm) has a smooth interior wall and annular exterior corrugations and provides 30 inch to 60 inch with smooth interior wall, exterior wall and an annular corrugated profile middle wall

ASTM D3212

10.8 psi laboratory test for watertightness

ASTM F1417

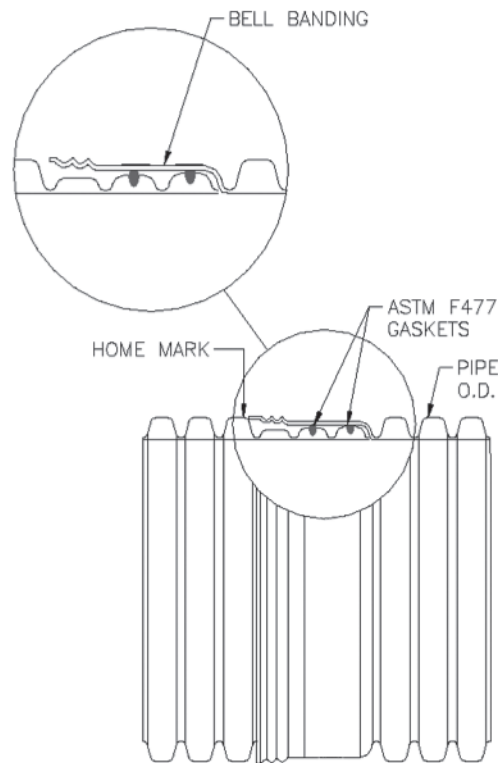
- Spigot have gaskets meeting requirements of ASTM F477
- 3.5 psi low pressure air test based on pipe diameter and run length

ASTM F2487

- Infiltration/Exfiltration test for watertightness (50-200) gal/in/mi/day
- Leakage rates are supplied by the manufacturer

ASTM F477

Bell & Spigot connections have a spun-on, welded or integral bell and spigot with gaskets



**PP joint detail may vary by manufacturer*

CMP – General Joint Info

Levels of joint performance:

Standard joint systems: Intended to control the infiltration of soil into the pipe

- Actual configuration can be based upon the gradation and plasticity of the backfill material around the pipe and groundwater elevation
- Several band and joint configurations available – at the manufacturer’s option
- May require a geotextile wrap around the exterior to meet service requirements

Gasketed or Special joint systems: Intended to limit the flow of water from the pipe interior to the backfill, limit the flow of groundwater into pipe, or provide further control of soil particle infiltration

- Several band and joint configurations available – at the manufacturer’s option
- ASTM A790: When required by owner: performance test at the plant –
 - o Leakage rate equivalent to 200 gallon per diameter inch per mile per day
 - o Straight alignment: Zero internal pressure
 - o Joint is not tested in the deflected or opened position
- Note that this test does not simulate the installed, fully loaded and deflected (oval) state of the pipe joint that will occur in the field.

AASHTO – Joint Selection Guidelines

Recently the AASHTO Standards on Materials (SOM) Committee published a new standard recommended practice which is intended to provide some design guidance as to when to specify different joint performance requirements for different pipe applications.

A tabular procedure is shown below. This standard also provides definitions of joint performance as follows:
Soil tight: A joint that is resistant to infiltration of particles larger than those retained on the No. 200 sieve. Soil tight joints provide protection against infiltration of backfill material containing high percentage of coarse grain soils, and are influenced by the size of the opening (maximum dimension normal to the direction that the soil may infiltrate) and the length of the channel (length of the path along which the soil may infiltrate).

Silt tight: A joint that is resistant to infiltration of particles that are smaller than particles passing the No. 200 sieve. Silt tight joints provide protection against infiltration of backfill material containing a high percentage of fines, and typically utilize some type of filtering or sealing component, such as an elastomeric rubber seal or geotextile.

Leak Resistant: A joint which limits water leakage at a maximum rate of 200 gallons/inch-diameter/mile/day for the pipeline system for the project specified head or pressure.

Special Design Joint – Joints requiring special strength in bending or shear, pull apart capabilities or unusual features such as restrained joints placed on severe slopes, welded joints or flanged and bolted joints for high pressures, high heads and velocities etc. typically described within special provisions of the project specifications.

The standard details required plant proof-of-design and installed field testing of each pipe joint system to qualify as meeting one of the joint types.

