ASTM D3034/IB & ASTM F679/IB PVC Gravity Sewer Pipe
Gasketed Integral Bell

INTRODUCTION

The PVC pipe industry has published consensus standards that represent the most comprehensive documents for installation requirements and best practices. NAPCO promotes the use of ASTM D2321, *Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications*, and ASTM F1668, *Standard Guide of Construction Procedures for Buried Plastic Pipe*, as the primary sources of installation guidelines for ASTM D3034 and ASTM F679 gasketed integral bell pipe.

For more detailed technical information, refer to the PVC Pipe Association's *Handbook of PVC Pipe Design and Construction*.

When necessary, we have presented additional information specific to our product offering.

The statements contained in this installation guide are those of NAPCO and are not warranties, nor are they intended to be warranties.

RECEIVING

Follow ASTM F1668, Section 5 and ASTM D2321, Section 8.

UV PROTECTION

AWWA M23, *PVC Pipe – Design and Installation*, pg. 7 states, "UV degradation of PVC pipe formulated for buried use will not have significant adverse effect with up to two full years of outdoor weathering and direct exposure to sunlight."

When PVC pipe is properly covered and not exposed to sunlight, the allowable storage time is unlimited. The two year criteria is a cumulative value of the time the pipe is in exposed storage and is not based on the date of manufacture.

It is important for the gasket in each pipe to be checked for hardening or cracking prior to assembly and installation. If a gasket has become hard or cracked,
the product should not be used.

TEMPERATURE CONSIDERATIONS

PVC will display a variation in physical properties with changes in temperature. Colder temperatures result in increases in pipe stiffness and tensile strength and decreases in impact strength. The decrease in impact strength requires care in handling during installation in cold temperatures.

The actual rate of expansion/contraction for PVC is 0.36 inch per 100 feet of pipe per 10°F temperature change. Stresses caused by thermal changes are rarely ever generated in PVC pipe due to gasketed joints absorbing any thermal movement.

TRENCH PREPARATION & CONSTRUCTION

Follow ASTM F1668, Sections 6, 7, & 8; and ASTM D2321, Sections 6 and 7.1 – 7.3.

BURIAL DEPTH

Minimum burial depth is governed by a few criteria. ASTM D2321, Section 7.6 states that "at least 24 in. or one pipe diameter for Class I embedment (whichever is larger), and a cover of at least 36 in. for Class II, III, and IV embedment (whichever is larger), before allowing vehicles or construction equipment to traffic the trench surface." This depth requirement increases to "at least 48 in. of cover before using a hydrohammer for compaction." NAPCO recommends that these requirements are followed during project design and construction.

AWWA C605, *Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings*, Section 7.2.8, recommends the following depths of cover to prevent pipe flotation:

- SDR 32.5 and Thicker Pipe – Depth of Cover of 1.5 pipe diameters
- SDR 41 – Depth of Cover of 2.0 pipe diameters.

Earth loads, from soil above a buried pipe, and live loads, from vehicles and objects on the surface, place vertical loads on the pipe that attempt to deform the pipe from a circle to an oval. The strength of the pipe wall, known as pipe stiffness, and the support afforded to the pipe by surrounding embedment soils counteracts these earth and live loads.

The Modified Iowa formula is widely used to calculate the expected in-situ deflection of PVC pipe at various depths and installation conditions. ASTM D3034, Section X2, recommends using 7.5% as the 30 day vertical cross-section ring deflection limit. We recommend that an engineer familiar with the Modified Iowa equation be consulted to determine if the embedment soil and pipe stiffness is adequate to counterbalance the loading conditions at specific burial depths.

A full discussion on this topic can be found in ASTM D2321, Section X1.

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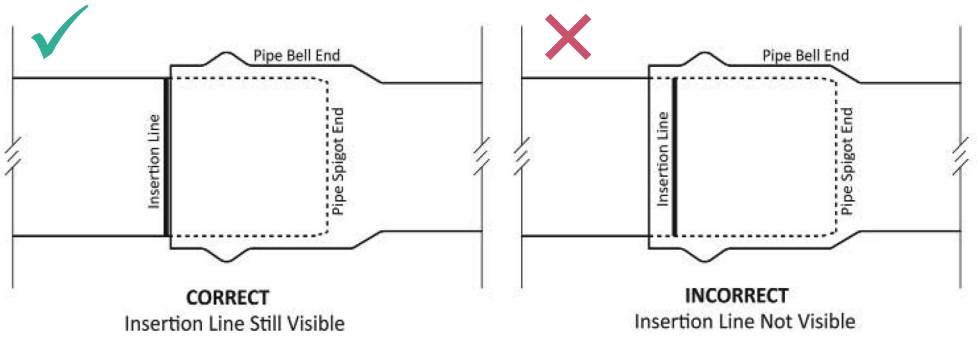

PIPE ASSEMBLY, INSTALLATION, & EMBEDMENT

Follow ASTM F1668, Sections 9, 10, 11, & 12; and ASTM D2321, Sections 5, 7.4 – 7.5.2, and Tables 1, 2, and 3.

NAPCO-SPECIFIC GUIDELINES ON PIPE JOINT ASSEMBLY

1. Inspect & Clean

Remove all dirt and other foreign material from the bell interior and spigot exterior that could prevent an effective seal between the bell and spigot. Carefully clean the gasket and the groove area around the gasket.

Inspect each gasket to ensure that it is seated uniformly in the groove by running your finger around the edge of the gasket. Look to see if the gasket has been damaged, cut, torn, or brittle. Set aside any questionable pieces of pipe.

DO NOT REMOVE THE GASKET FROM THE GROOVE FOR CLEANING. The gasket is not removable and will be damaged by attempts to remove it.

2. Lubricate

Lubricant should be applied to the bevel and exterior pipe wall of the spigot approximately mid-way back to the insertion line. Additionally, apply lubricant to the inside surface of the gasket in the bell. Only use supplied or approved lubricants. Lubricants for use with potable water pipelines must also be safe for potable water usage.

3. Assemble

Prior to joint assembly, both pipe segments must be in straight alignment to prevent gasket tearing or rollout during insertion.

Push the lubricated spigot end into the bell beyond the gasket. The bar and block method of assembly is recommended as the worker is able to the feel the amount of force being used and whether the joint slides together smoothly. Larger pipe will require mechanical assistance to apply sufficient force to assemble the joint.

Pipe spigots are marked with an insertion line that indicates how far the spigot is to be inserted in to the bell. DO NOT OVER INSERT THE JOINT. Correct assembly of the pipe joint is shown above. Ensure that previously joined pipe segments are not disturbed or over inserted as the pipeline assembly progresses.

For single insertion line products, the spigot should be pushed into the adjoining bell until the edge of the bell is flush with the insertion line. The line should be visible.

JOINT ASSEMBLY PROBLEMS

If there is trouble assembling the joint, disassemble and examine the gasket. Be sure the gasket is properly seated and both pipe segments are in straight alignment. If the gasket is damaged, cut off the bell, bevel the new edge, and use a coupling to assemble the two pipe segments.

If the pipe is misaligned, over-inserted, or assembled with excessive force, the following are possible consequences:

- Rolled or torn gaskets,
- Split bells,
- Acceptance testing failure (e.g. hydrostatic pressure test),
- Leaky joints after temperature changes or earth movement,
- Damage to previously assembled joints.

BELL & SPIGOT ORIENTATION

NAPCO recommends that the pipe's bell end points in the direction of work progress. When joining pipe, it is easier to insert the spigot into the bell than it is to push the bell over the spigot. This also reduces the risk of soil or rubble being scooped under the gasket during assembly.

The direction of the pipe bell relative to the flow direction does not affect the performance of the pipe joint or system hydraulics.

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INSTALLING PIPE THROUGH CASINGS
Follow ASTM F1688, Section 16.

CONNECTING PIPE TO APPURTENANCES & FITTINGS
Follow the instructions of the appurtenance or fitting manufacturer including pipe trimming, pipe insertion, and bolt tightening guidelines. Appurtenances & fittings must be compatible with ASTM D3034 or ASTM F679 PVC pipe sizes.

Mechanical restraint rings typically have grooved pads that bite into the pipe. These grooved pads place acceptable indentations into the pipe. In the event of removing the restraint ring from the pipe, the section of PVC pipe with the indentations should be cut-off and discarded. The same area of PVC pipe should not be re-indented as the strength of the pipe will be compromised.

FIELD CUTTING
Pipe can be easily cut with a power saw using an abrasive disc. Other cutting tools may be appropriate, depending on the size of the pipe. It is recommended that the pipe be marked around its entire circumference prior to cutting to ensure a square cut. Both portions of the pipe on either side of the cut line should be supported from below such that neither portion of pipe pulls at the other while it is being cut.

If inserting into a gasketed joint, the newly cut pipe will need to be beveled and have the insertion marks redrawn. Use a factory-finished beveled spigot end as a guide for proper bevel angle and depth. Draw a new insertion mark at the same distance as the original.

PIPE BENDING & JOINT ANGULAR DEFLECTION
Some changes in direction may be accomplished without the use of elbows, sweeps or other fittings. Changes in direction can be accomplished by pipe bending or through angular joint deflection, BUT NOT BOTH, on the same segment of pipe.

Angular Joint Deflection
The maximum angular joint deflection for all NAPCO ASTM D3034 & ASTM F679 PVC pipe sizes and pressure classes is 1°. Table 1 provides the maximum offset at the end of the deflected pipe for various lay lengths.

Longitudinal Bending
Due to the flexible nature of PVC, longitudinal bending of PVC pipe is possible as long as the flexural stress limits of the pipe are observed.

Table 1: Gasketed Integral Bell Joint Angular Deflection Maximum Offset

Lay Length	Maximum Offset	
ft.	ft.	ft.
14	0.24	2-15/16
20	0.35	4-3/168

We recommend that only manual force be used to bend PVC pipe in open-cut trench installations. Using mechanical equipment could easily surpass the allowable flexural stress limits of the pipe. For this reason, longitudinal bending of pipe sized larger than 15" is not recommended due to the large forces required.

Table 2 displays the minimum bend radius, maximum angle of lateral deflection, and the maximum distance offset at the end of a flexed, solid wall pipe.

THRUST RESTRAINT
Follow ASTM F1668, Section 19. Follow all thrust restraint manufacturer's requirements for installation methods especially bolt tightening specifications. Improper installation of external restraints can result in loss of joint seal or fracture of the pipe wall.

BACKFILL
Follow ASTM D2321, Sections 5, 7.5 – 7.6, X1, and Tables 1 and 2; and ASTM F1668, Section 13, 14, 17 & 18. Requirements for maximum particle sizes are contained therein.

VERTICAL RISERS
Follow ASTM D2321, Section 7.7 and ASTM F1668, Section 15.

SERVICE CONNECTIONS
Follow ASTM D2321, Section 7.8.

MANHOLE CONNECTIONS
Follow ASTM D2321, Section 7.10 and ASTM F1668, Section 15.

DEFLECTION TESTING
After 30 days post-installation, a properly sized go, no-go mandrel can be pulled through the buried pipeline to check the long-term vertical ring deflection before final acceptance. Follow ASTM F1668, Section 20.1 – 20.3 and X1.

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LEAKAGE TESTING

Leakage testing using low-pressure air is permitted for buried sewer D3034 and F679 pipelines. Follow ASTM F1668, Section 21.1 – 21.2 and ASTM F1417, *Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air.*

Table 2: Longitudinal Bending of ASTM D3034 Pipe

		14' Lay Length		20' Lay Length	
Nom. Size	Min. Bend Radius	Max. Deflection Angle	Max. Offset of Flexed Pipe	Max. Deflection Angle	Max. Offset of Flexed Pipe
	ft.	deg.	ft.	deg.	ft.
4	35.13	11.4	2.75	16.3	5.54
6	52.29	7.7	1.86	11.0	3.78
8	70.00	5.7	1.40	8.2	2.84
10	85.00	4.7	1.15	6.7	2.34
12	104.17	3.9	0.94	5.5	1.91
15	127.50	3.1	0.77	4.5	1.57