PLUMBING

INSTALLATION GUIDE

Non-Pressure Solvent Welded PVC Pipe | Underground Applications

INTRODUCTION

The PVC pipe industry has published consensus standards that represent the most comprehensive documents for installation requirements and best practices. For PVC pipe used in underground non-pressure applications, NAPCO promotes the use of the following standards as the primary sources of installation guidelines:

- ASTM D2321, *Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications*
- ASTM D2855-15, *Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings*
- ASTM F1668, *Standard Guide for Construction Procedures for Buried Plastic Pipe*
- IAPMO UPC 1, *Uniform Plumbing Code*

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, HANDLING, & STORAGE

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.

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. Thermal expansion/contraction causes stress in the pipe walls for solvent welded PVC pipe and must be mitigated by the use of expansion joints or other thermal stress management techniques.

Follow IAPMO UPC, Section IS 9-2006.2.3.2 for building sewer and drain lines.

TRENCH PREPARATION & CONSTRUCTION

Follow ASTM F1668, Sections 6, 7, & 8; and ASTM D2321, Sections 6 and 7.1 – 7.3. Follow IAPMO UPC, Section 314 & 720 for building sewer and drain lines.

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.

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.

BELL & SPIGOT ORIENTATION

NAPCO recommends that the pipe's bell end points 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 into the bell 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.

CLEANERS, PRIMERS & SOLVENT CEMENTS

Follow ASTM D2855-15, Section 6.2, 6.3, and 6.4.

PIPE CUTTING & JOINT PREPARATION

Follow ASTM D2855-15, Section 7.1 through 7.6.

APPLICATION OF PRIMER AND CEMENT

Follow the procedure detailed in ASTM D2855-15, Section 7.7.

COLD & HOT WEATHER NOTES Follow ASTM D2855-15, Section 8.4 and 8.5.

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 the pipe size.

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.

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

Solvent welded PVC pipe does not permit angular deflection at the joint.

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.

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.

Tables 1, 2, and 3 contain the minimum bend radius, maximum angle of lateral deflection, and the maximum distance offset at the end of a flexed, solid wall pipe.

It is not recommended to bend ASTM F891 cellular core pipe.

THRUST RESTRAINT

Solvent welded PVC pipe and fitting joints generally do not require additional thrust restraint methods. In the instance of connections made via other methods, 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, 2, and 3; 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.

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SERVICE CONNECTIONS

Follow ASTM D2321, Section 7.8.

MANHOLE CONNECTIONS

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

ACCEPTANCE TESTING

Follow ASTM D2321, Section 7.9, X1.13; ASTM F1668, Sections 20.1 – 20.3; and ASTM F1417, *Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air.*

Table 1: Longitudinal Bending of ASTM D2665 Pipe

		10' Pipe Segments		20' Pipe Segments	
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.
¾	8.75	32.7	5.12	65.5	14.49
1	10.96	26.1	4.26	52.3	13.72
1¼	13.83	20.7	3.46	41.4	12.11
1½	15.83	18.1	3.05	36.2	11.04
2	19.79	14.5	2.47	29.0	9.28
2½	23.96	12.0	2.06	23.9	7.88
3	29.17	9.8	1.70	19.6	6.59
4	37.50	7.6	1.33	15.3	5.21
6	55.21	5.2	0.90	10.4	3.58
8	71.88	4.0	0.69	8.0	2.77
10	89.58	3.2	0.56	6.4	2.22
12	106.25	2.7	0.47	5.4	1.88

Table 2: Longitudinal Bending of ASTM D2729 & ASTM D3034 Pipe

		10' Pipe Segments		14' Pipe Segments		20' Pipe Segments	
Nom. Size	Min. Bend Radius	Max. Deflection Angle	Max. Offset of Flexed Pipe	Max. Deflection Angle	Max. Offset of Flexed Pipe	Max. Deflection Angle	Max. Offset of Flexed Pipe
	ft.	deg.	ft.	deg.	ft.	deg.	ft.
3	27.08	10.58	1.83	14.8	3.54	21.2	7.06
4	35.13	8.16	1.41	11.4	2.75	16.3	5.54
6	52.29	5.48	0.95	7.7	1.86	11.0	3.78
8	70.00	4.09	0.71	5.7	1.40	8.2	2.84
10	85.00	3.37	0.59	4.7	1.15	6.7	2.34
12	104.17	2.75	0.48	3.9	0.94	5.5	1.91
15	127.50	2.25	0.39	3.1	0.77	4.5	1.57

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Table 3: Longitudinal Bending of ASTM D2949 Pipe

10' Pipe Segments			
Nom. Size	Min. Bend Radius	Max. Deflection Angle	Max. Offset of Flexed Pipe
	ft.	deg.	ft.
3.25	27.08	10.6	1.83