INSTALLATION GUIDE FOR

GASKETED-JOINT PVC PRESSURE PIPE

PVCPIPE association

PRESSURE PIPE

TABLE OF CONTENTS

PRESSURE PIPE

INTRODUCTION:

This document has been developed by the Uni-Bell PVC Pipe Association for use as a field installation guide. General information regarding the correct installation of gasketed-joint PVC pressure pipe is included. Relevant product standards are:

- American Water Works Association (AWWA) C900 "Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in., for Water Distribution"
- AWWA C905 "Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. through 48 in., for Water Transmission and Distribution"
- AWWA C907 "Standard for Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 in. through 12 in., for Water, Wastewater, and Reclaimed Water Service"
- AWWA C909 "Standard for Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in. through 24 in., for Water, Wastewater, and Reclaimed Water Service"

For more detailed information, consult the pipe manufacturer or refer to AWWA C605 "Standard for Underground Installation of PVC and PVCO Pressure Pipe and Fittings," and AWWA Manual M23 "PVC Pipe – Design and Installation." The *Handbook of PVC Pipe: Design and Construction* provides additional guidance on PVC pipe design and installation. For information on this publication, please contact Uni-Bell.

The Uni-Bell PVC Pipe Association, formed in 1971, funds PVC pipe research and development, provides technical service and support, develops recommended standards, and promotes proper use of PVC pipe with gasketed joints.

Uni-Bell members are manufacturers who are dedicated to producing high quality PVC pipe products for the industry.

The statements contained in this installation guide are those of the Uni-Bell PVC Pipe Association and are not warranties, nor are they intended to be warranties. Inquiries for information on specific products, their attributes and recommended uses, and the manufacturer's warranty should be directed to member companies.

RECEIVING:

When a load of pipe arrives at the job site, it is your responsibility to check it thoroughly. If possible, inspect each piece for damage. Check quantities against the shipping list. Note that once the pipe leaves the manufacturer's plant, it becomes the property of the trucker. Any damaged or missing items must be documented on the bill of lading. Set aside any damaged items and notify the shipper.

PRESSURE PIPE

UNLOADING AND HANDLING:

It is also your responsibility to unload the shipment. UNLOAD WITH REASONABLE CARE. Careless unloading can result in damaged product or personal injury.

Use a forklift or a front-end loader with fork attachment, if available. Make sure that the forks are long enough to support the bundles. When unloading by hand, remove one piece at a time and block the shipment to keep pipe from rolling off the truck.

Follow the following precautions:

- DO NOT drop pipe off the truck.
- DO NOT insert a forklift fork into a pipe end to transport.
- Lower the pipe into the ditch. DO NOT drop.

PRESSURE PIPE

The table below is provided for use as a guide in selection of handling equipment:

APPROXIMATE WEIGHT OF 20-FOOT PIPE LENGTHS (lbs)

PVC Pressure Pipe *CIOD*

Pipe Size	DR	DR	DR	DR	DR	DR	DR
(in.)	51	41	32.5	25	21	18	14
4	x	x	x	38	x	52	66
6	x	x	x	79	x	110	140
8	x	x	x	140	x	190	230
10	x	x	x	200	x	280	350
12	x	x	x	290	x	390	500
14	x	240	300	390	460	530	670
16	x	310	390	500	590	690	870
18	320	390	490	630	740	860	1100
20	390	480	600	770	910	1100	x
24	550	680	860	1100	1300	1500	x
30	850	1100	1300	1700	2000	2300	x
36	1200	1500	1900	2400	2900	x	x
42	1600	2000	2600	3300	3900	x	x
48	2100	2700	3300	4300	x	x	x

PVC Pressure Pipe *IPS*

Pipe Size	DR	DR	DR	DR	DR
(in.)	41	32.5	26	21	17
4	21	26	32	40	48
6	45	57	70	86	100
8	76	100	120	150	180
10	120	150	180	230	280
12	170	210	260	320	390
14	200	250	310	380	470
16	260	330	410	500	610
18	330	420	520	630	770
20	410	520	640	780	1000
24	590	740	900	1100	1400
30	930	1200	1400	1800	2200
36	1300	1700	2100	2500	3100

PRESSURE PIPE

STORAGE:

If you can unload the shipment in unit packages, the pipe will be easier to store. Stack the packages on reasonably level ground. If you unload one piece at a time, place the pipe bevel to bell. Never stack more than eight feet in height. Do not stack the pipe next to heat sources or engine exhausts. Gaskets should also be protected from heat, oil, and grease.

PRESSURE PIPE

TRENCHING:

Do not let the excavated material block sidewalks, drives, or utility outlets. Follow all safety rules and regulations. Protect workers by using sheeting and trench boxes in hazardous areas and by sloping the trench walls in dry soils. When sheeting or a trench box is moved, make sure that the pipe is not moved and that the side-support material is not disturbed.

For information on trench terminology and recommended practices, see the “Trench Construction” section.

PRESSURE PIPE

DE-WATERING:

Keep the trench as dry as possible until the pipe has been installed and enough backfill placed to prevent the pipe from floating. PVC pipe will float if not filled with water or weighted down. The height of loose backfill material required to prevent flotation of empty pipe is conservatively equal to 1½ times the pipe diameter.

FIELD CUTTING:

PVC pipe can be easily cut with a power handsaw or power-driven abrasive disc. Be sure you make a square cut. Bevel the end with a beveling tool, wood rasp, or power sander to the same angle and length as provided on the factory-finished pipe. Redraw the insertion line on the spigot using a factory-marked spigot as a guide.

PRESSURE PIPE

LOWERING PIPE INTO THE TRENCH:

Place the pipe and fittings into the trench using ropes and skids, slings on the backhoe bucket, or by hand. Do not throw the pipe or fittings into the trench or allow any part of the pipe to take an unrestrained fall onto the trench bottom. At this point, the pipe and other accessories are in a good position for final inspection. Ensure there are no damaged materials before assembly begins.

CLEANING AND INSPECTION:

Gaskets may be supplied separately or already installed in the pipe. See the pipe manufacturer's literature for more information.

When gaskets are supplied separately, make sure they are clean and dry before insertion in the bell groove. The gasket groove and spigot should be wiped clean and dried before assembly.

When gaskets are already installed in the pipe, the gaskets, the groove area behind the gaskets, and the pipe spigot ends should be wiped clean. Check each gasket to insure that it is inserted uniformly into the race.

DO NOT REMOVE THE GASKETS FROM THE RACE FOR CLEANING. Many gaskets are not removable and will be damaged by attempts to remove them.

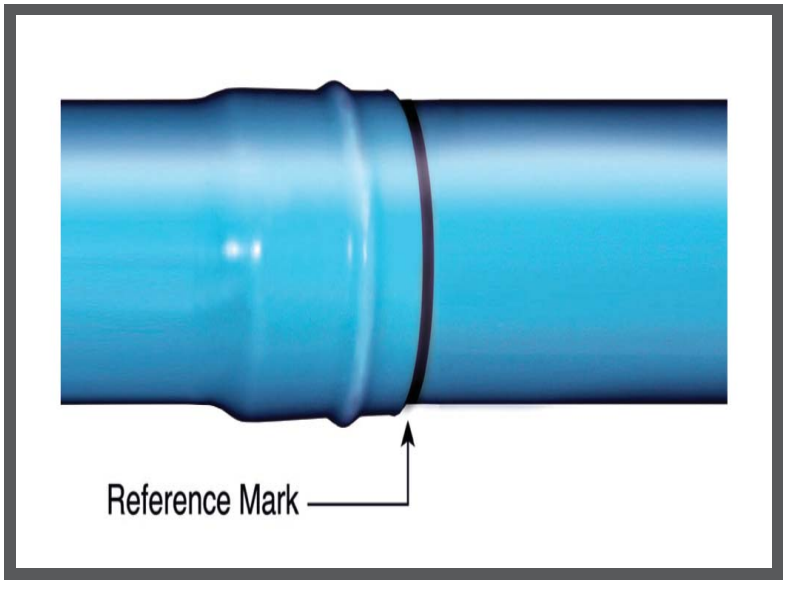
PRESSURE PIPE

LUBRICATION:

Lubricant should be applied to the bevel of the spigot end and approximately mid-way back to the insertion line. Some manufacturers recommend applying lubricant to the gasket surface which makes contact with the spigot end. Use only the lubricants supplied or recommended by the pipe manufacturer.

JOINT ASSEMBLY:

Push the lubricated spigot end past the gasket into the bell until the insertion line on the spigot is even with the edge of the bell. DO NOT OVERINSERT.

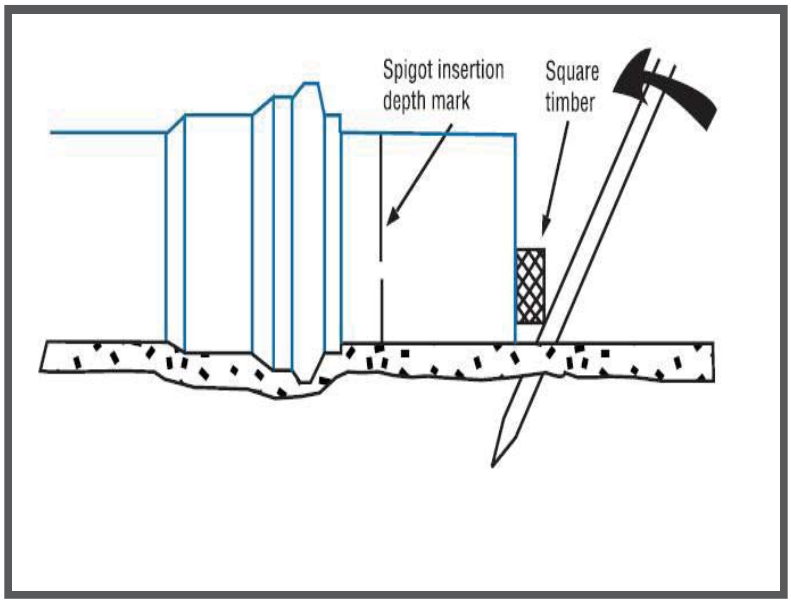


If you have trouble with assembly, disassemble the joint and examine the gasket. If the gasket is removable, replace if damaged. If non-removable gaskets are damaged, cut off the bell, bevel the new edge, and use a coupling to assemble. Be sure that the gasket is properly seated and that both pipe lengths are in straight alignment. Repeat assembly steps as stated on previous page. Correct assembly is achieved when the insertion line on the spigot is lined up with the edge of the bell. If multiple insertion lines exist, insert until only one line is visible.

The bar-and-block method of joint assembly is recommended, as the installer is able to feel the amount of force being used and whether the joint goes together smoothly. Larger pipe may require mechanical assistance to apply sufficient force to assemble the joint.

When mechanical devices are used, care must be taken to ensure that the spigot is inserted to the proper depth and that previously assembled pipe joints are not disturbed. This is accomplished by inserting only to the insertion line on the spigot end. If the spigot is over-inserted, back the pipe out until the insertion line is visible. In all cases, straight alignment of the pipe is essential for proper assembly. If the pipe is misaligned, over-inserted, or assembled with excessive force, the following are possible consequences:

- rolled gasket
- split bell
- failure to pass acceptance testing (e.g., hydrostatic pressure test)
- over-insertion of previously assembled joints



Manual Bar-and-Block Method

PRESSURE PIPE

INSTALLING PIPE THROUGH CASINGS:

When the pipeline intercepts a heavily traveled, protected, or landscaped area it may be necessary to install the pipe through a casing. There are four precautions to observe while pushing the pipe through the casing:

1. Install spacers on the PVC pipe.

2. Minimize the friction force during the push.

3. Avoid over-insertion.

4. Install a water-permeable seal at the casing ends.

Casing size: The casing should be large enough to readily accommodate the maximum outside diameter at the pipe bells and the projections of the supporting spacers. The casing should not be so large as to permit excessive "whipping" or "snaking" of the PVC pipe when it is pressurized.

Casing spacers: Casing spacers are available to provide proper separation between the casing and the PVC pipe to be installed. Spacers come complete with runners to provide clearance for the bell-and-spigot assemblies. The casing-spacer manufacturer should be contacted for information on the location and number of spacers required.

INSTALLATION OF FITTINGS AND VALVES:

The insertion depths of valve and fitting joints are usually less than those of PVC pipe joints. For proper insertion depth of PVC fittings, check with the manufacturers of the fittings. For iron fittings, cut the spigot end to remove the factory bevel. Make sure the pipe spigot end is squarely cut, deburred, and the sharp edge removed. Insert the pipe spigot into the iron fitting bell until the pipe end contacts the fitting. See AWWA Standard C605 "Standard for the Underground Installation of PVC and PVCO Pressure Pipe and Fittings."

Joint Restraint Devices: Mechanical thrust-restraint devices are available which clamp to the wall of the pipe and tie back to a mating collar on the fitting or pipe bell. Integral self-restraining bell and spigot joints are also available. Contact the joint restraint manufacturer for installation recommendations.

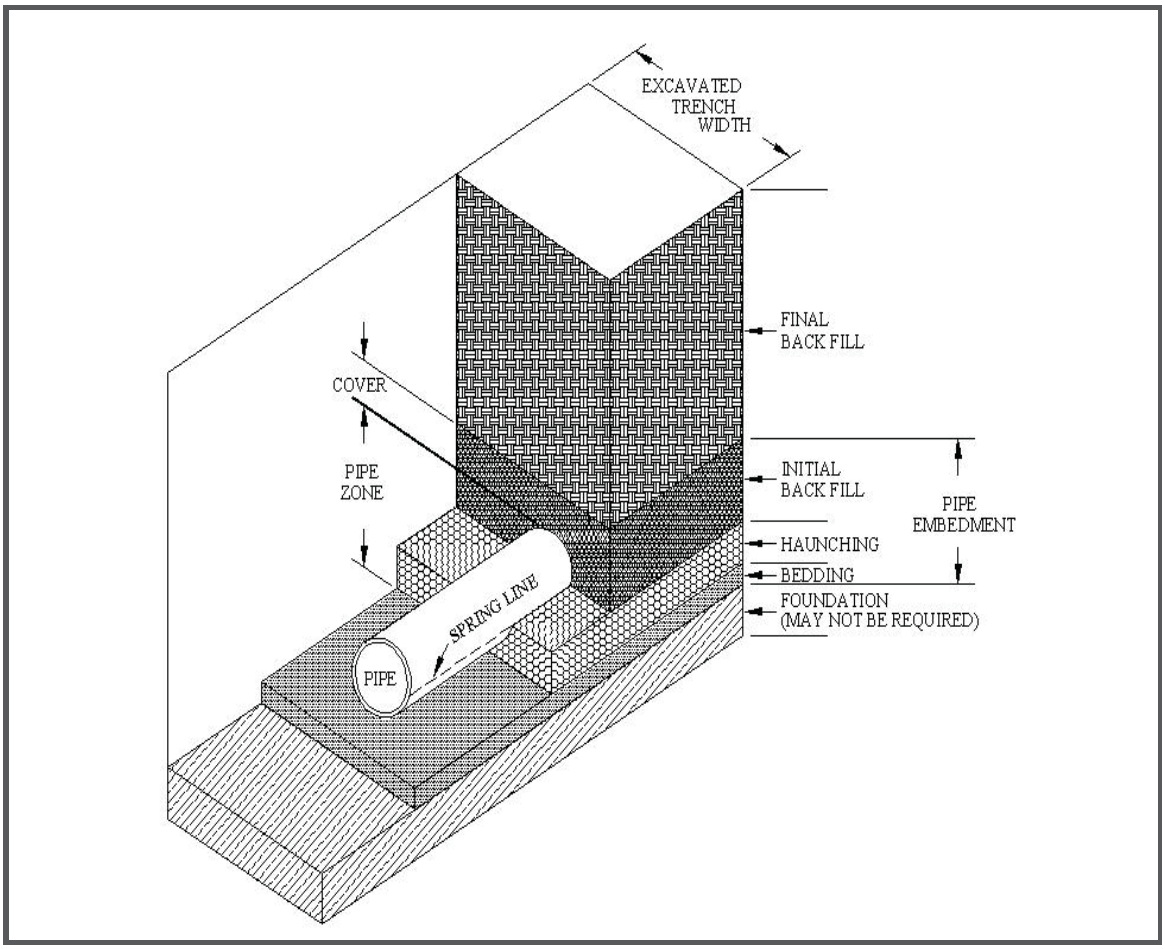
TRACER WIRE:

Properly installed tracer wire will aid in locating PVC pipe. Typically, an insulated wire or plastic-coated metal strip is laid above the pipe after installation. The tracer wire is generally accessible at a riser, but is not electrically connected to the riser.

PRESSURE PIPE

TRENCH CONSTRUCTION:

Terms used in pipe installation are illustrated in the trench cross-section below. The use of proper embedment materials is very important to minimize trench settlement. For pipe from 4-inch through 12-inch diameter, the particle size of material in contact with the pipe shall not exceed ¾-inch for angular rock and 1½ inches for round rock. For 14-inch diameter and larger pipe, maximum particle size in contact with the pipe is 1½ inches.



FOUNDATION:

A foundation is required when the trench bottom is unstable. The bottom of the trench is over-excavated and brought back up to grade with suitable material. Where over-excavation occurs, ensure that the elevation under the entire length of the pipe is brought up (rather than only at the bells). Proper placement of over-excavated materials will provide proper support of the pipe and will prevent sagging between joints.

PRESSURE PIPE

BEDDING:

Bedding may be used to bring the trench bottom up to grade before the pipe is installed. The purpose of bedding is to provide continuous support under the pipe. Where required (such as when rock is encountered), a minimum depth of 4 to 6 inches is typical.

Holes for pipe bells should be provided at each joint to ensure uniform support for the pipe. Bell holes should be no larger than necessary for pipe assembly.

HAUNCHING:

Proper placement of material in the haunch reduces voids and increases pipe support. If granular materials are used, they may be properly placed using techniques such as shovel slicing. Place material under the haunches and at least halfway up the pipe to provide side support. Make sure material is properly compacted. DO NOT DISTURB SIDE SUPPORT WHEN MOVING SHEETING OR TRENCH BOX.

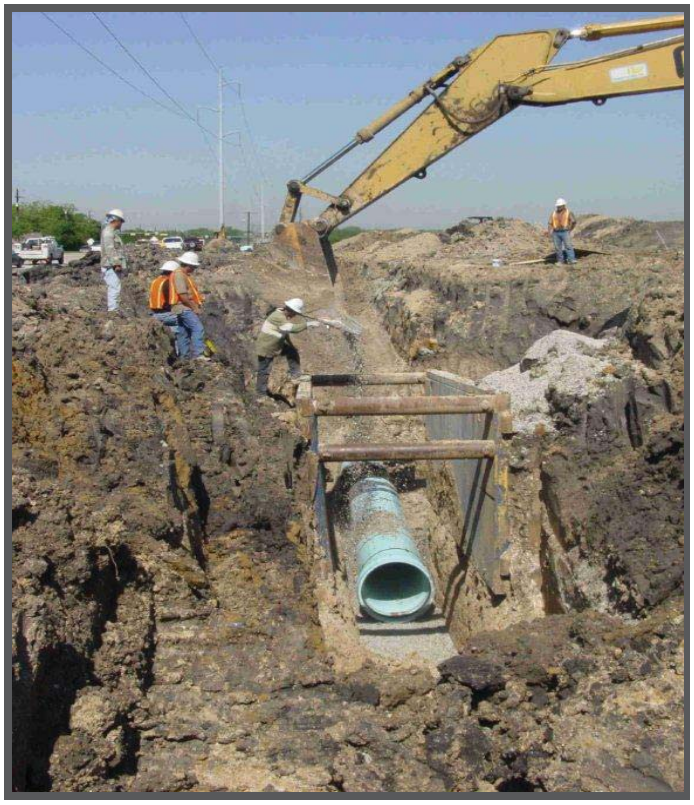
The pipe stiffness and anticipated loadings will dictate whether or not granular material and/or compaction of the haunch material are necessary.

PRESSURE PIPE

INITIAL BACKFILL:

The material placed over the crown of the pipe to a height of 6 to 12 inches is the initial backfill. The purpose of the initial backfill is to protect the pipe from the final backfill. Where not otherwise specified, the initial backfill may consist of the native material in the trench provided it is not frozen and is free from large stones, debris, and other organic materials.

Machine compaction of initial backfill directly over the pipe is not desirable unless adequate cover has been provided to protect the pipe. The required depth of cover will depend on the type of compaction equipment – consult the project engineer for information.



FINAL BACKFILL:

Final backfill is often specified by the project engineer based on site design. Material selection, placement, and compaction should meet the project requirements. In many cases, the material that was originally excavated can be used for final backfill.

PRESSURE PIPE

COMPACTING THE BACKFILL:

Compact the haunching, initial backfill, and final backfill in accordance with the job drawings. Observe the following precautions:

- When a “self-compacting” material is used (such as crushed stone), ensure that the material does not arch or bridge beneath the haunch of the pipe. Remove such voids by shovel slicing.

- When compacting the material underneath and at either side of the pipe, do not allow the tool or the machine to strike the pipe.

It is not necessary to compact the initial backfill directly over the top of the pipe for the sake of the pipe’s structural strength. However, it may be necessary for roadway integrity and for minimizing trench settlement.

OVERNIGHT PRECAUTIONS:

At the end of each workday, be sure that all installed pipe ends are covered to keep dirt, debris, and animals from entering the pipe. Backfill as needed to avoid flotation.

ACCEPTANCE TESTING:

General: When local conditions require that trenches be backfilled immediately after pipe has been laid, testing may be carried out after backfilling has been completed. In all cases, sufficient backfill (minimum depth 1½ times the pipe size) shall be placed to confine the pipe system during testing.

The engineer shall assure that the test pressure does not exceed the design pressure of any of the components of the pipe system.

Procedure: Testing shall be performed only after the pipeline has been properly filled, flushed, and purged of all air. The specified test pressure shall be applied by means of an approved pumping assembly connected to the pipe in a manner satisfactory to the purchaser. To prevent pipe movement, the contractor shall have placed sufficient backfill prior to filling and testing of the pipe. The test pressure shall not exceed the test pressure specified by the engineer. If necessary, the test pressure shall be maintained by additional pumping for the specified time during which the system and all exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage. All visible leaks shall be stopped. All defective elements shall be repaired or removed and replaced. The test shall be repeated until the test requirements have been met.

Test Duration: The duration of the hydrostatic test shall be 2 hours, unless otherwise specified.

PRESSURE PIPE

Test Pressure: The hydrostatic test pressure shall not be less than 125% of the maximum anticipated sustained working pressure at the highest point along the test section unless the pressure exceeds the design pressure limit for any component of the test section. In no case shall the test pressure exceed the design pressure limit for any component, including pipe, valve, fitting, thrust restraint, or other appurtenance.

Test Allowance: The testing allowance shall be defined as the quantity of water that must be supplied to the pipe section being tested to maintain a pressure within 5 psi of the specified hydrostatic test pressure.

Make-up water allowances are provided in the table below:

HYDROSTATIC TEST MAKE-UP WATER ALLOWANCE

(U.S. Gallons per Hour Per 1000 Feet of PVC Pipe)

Pipe Size	Average Pressure in Line (psi)				
(in.)	50	100	150	200	250
4	0.19	0.27	0.33	0.38	0.43
6	0.29	0.41	0.50	0.57	0.64
8	0.38	0.54	0.66	0.76	0.85
10	0.48	0.68	0.83	0.96	1.07
12	0.57	0.81	0.99	1.15	1.28
14	0.67	0.95	1.16	1.34	1.50
16	0.76	1.08	1.32	1.53	1.71
18	0.86	1.22	1.49	1.72	1.92
20	0.96	1.35	1.66	1.91	2.14
24	1.15	1.62	1.99	2.29	2.56
30	1.43	2.03	2.48	2.87	3.21
36	1.72	2.43	2.98	3.44	3.85
42	2.01	2.84	3.48	4.01	4.49
48	2.29	3.24	3.97	4.59	5.18

When testing against closed metal-seated valves, an additional allowance per closed valve of 0.0078 gallon per hour per nominal inch of valve size shall be allowed. When hydrants are in the test section, the test shall be made against closed hydrant valves.

Should the make-up water volume exceed the testing allowance, it is probable that the system has a leak that must be located and repaired.

Having a make-up water volume below the testing allowance indicates a successful test. Since PVC gasketed pipe is a leak-free system, low volumes of make-up water do not indicate a leak. Instead make-up water is necessary to accommodate entrapped air, slight movement of the pipe at thrust restraints, or a small increase in interior pipe volume due to radial expansion.

SPECIAL CONSIDERATIONS:

Changes in Direction:

1. Pipe bending – Some changes in direction may be accomplished without the use of bends, sweeps, or other fittings. Controlled bending within acceptable limits can be accommodated by PVC pipe. A general rule of thumb for the minimum bending radius (R_b) calculation is R_b = 250 OD. Tighter bending radii may be achieved for certain products. Consult the manufacturer for specific product information. In most cases, bending should be accomplished manually. It is not recommended to attempt bending pipes greater than 12” in diameter due to the forces required.

2. Joint deflection – Changes in direction may also be accomplished through joint deflection. Allowable joint deflection is dependent on pipe size and joint design. Joint deflection limits should be obtained from the pipe manufacturer.

3. Combined pipe bending and joint deflection – Either joint deflection or longitudinal bending may be used for changes in direction, BUT NOT BOTH on the same length of pipe.

Cold-Weather Installation: Extremely cold 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.

Disinfection: For information on the procedures for disinfecting water mains, refer to AWWA C651, “Disinfecting Water Mains.”

Tapping: For information on tapping of PVC pressure pipe, see the Uni-Bell website.

PRESSURE PIPE

CHECKLIST:

- Take all precautions necessary to protect workers and materials.
- Plan ahead for fittings.
- Use trench boxes or shoring as required.
- Do not disturb installed pipe when moving trench boxes or shoring materials.
- Properly assemble pipe joints by inserting the spigot end until the insertion line is even with the bell lip.
- Keep the trench bottom as dry as possible.
- For detailed installation recommendations, see AWWA C605 “Standard for Underground Installation of PVC and PVCO Pressure Pipe and Fittings.”
- Consult the pipe manufacturer for specifics regarding gaskets and lubricants.
- Check with the project engineer regarding specifications and procedures.

PRESSURE PIPE

UNI-BELL LITERATURE:

Recommended Standards

UNI-B-1 “Recommended Specifications for Thermoplastic Pipe Joints, Pressure and Non-Pressure Applications”

UNI-B-8 “Recommended Practice for the Direct Tapping of Polyvinyl Chloride (PVC) Pressure Water Pipe (Nominal Diameters 6-12 Inches)”

UNI-B-15 “Recommended Standard Specification for Polyvinyl Chloride (PVC) Fabricated Pressure Fittings”

Technical Reports

UNI-TR-1 “Deflection: The Pipe/Soil Mechanism”

UNI-TR-5 “The Effects of Ultraviolet Radiation on PVC Pipe”

UNI-TR-6 “PVC Force Main Design”

UNI-TR-7 “Thermoplastic Pressure Pipe Design”

PRESSURE PIPE

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