

SOLVENT WELD
PLUMBING / IRRIGATION
ELECTRICAL CONDUIT

ANSI/UL 651 AND NEMA TC-2, TC-6 AND 8

INSTALLATION GUIDE



*Building essentials
for a better tomorrow™*

 **WARNING**

RUPTURE HAZARD

IMPROPER INSTALLATION OR MISUSE OF TAPPING TOOLS MAY CAUSE PIPES UNDER HIGH PRESSURE TO RUPTURE AND RESULT IN HIGH VELOCITY AIRBORNE FRAGMENTATION LEADING TO SERIOUS INJURIES.

• **BEFORE AND DURING INSTALLATION, ALWAYS:**

- CONSULT AND FOLLOW THE FULL VERSION OF THE PRODUCT INSTALLATION GUIDE
- CLOSELY FOLLOW JOB SPECIFICATIONS
- USE PROTECTIVE GEAR AND EQUIPMENT

• **BEFORE AND DURING TAPPING, ALWAYS:**

- CONSULT AND FOLLOW UNI-BELL® PUBLICATION UNI-PUB-08-07, "TAPPING GUIDE FOR PVC PRESSURE PIPE."
- USE THE CORRECT TAPPING TOOLS
- BLEED AIR FROM PIPES AT HIGH SPOT BEFORE TAPPING
- USE PROTECTIVE GEAR AND EQUIPMENT

PLEASE CONTACT JM EAGLE™ PRODUCT ASSURANCE AT (800) 621-4404 TO OBTAIN FULL VERSION OF THE APPROPRIATE INSTALLATION GUIDE OR FOR FURTHER ASSISTANCE.

SOLVENT WELD

CONTENTS

1.0	RECEIVING AND HANDLING PIPE SHIPMENTS	8
1.1	INSPECTION	8
1.2	UNLOADING	9
1.3	COLD-WEATHER HANDLING	11
1.4	STOCKPILES	11
1.5	LOADING TRANSFER TRUCKS	12
1.6	DISTRIBUTING ALONG THE TRENCH	12
2.0	TRENCH CONSTRUCTION	13
2.1	WORKING AHEAD OF THE PIPE LAYING CREW	13
2.2	CURVES IN THE TRENCH	13
2.3	TRENCH WIDTHS	15
2.4	TRENCH DEPTHS	16
2.5	PLANNING FOR THRUSTING	16
2.6	PREPARATION OF TRENCH BOTTOM	17
3.0	PIPELINE CONSTRUCTION	18
3.1	INSPECTION	18
3.2	LOWERING PIPE AND ACCESSORIES INTO TRENCH	18
3.2.1	SNAKING	18
3.3	ABOVE-GROUND INSTALLATION	19
3.4	MAKING SOLVENT CEMENTED JOINTS FOR PVC AND ABS	20
3.5	CUTTING	25
3.6	BEVELING	25
3.7	ASSEMBLY AT FITTINGS AND ADAPTORS	26

3.8	THRUST BLOCKING AND ANCHORAGE AT FITTINGS	27
3.8.1	DETERMINING SIZE AND TYPE OF THRUST BLOCKING	27
3.8.2	UPWARD THRUSTS AT FITTINGS	28
3.8.3	ANCHORAGE OF PIPE ON SLOPES	28
3.8.4	ANCHORAGE OF VALVES IN THE LINE	29
3.8.5	CONSTRUCTION OF THRUST BACKING	29
3.9	THRUST-RESTRAINT JOINTS OF SOLVENT WELD PIPE	30
3.10	SERVICE CONNECTIONS	30
3.10.1	PRESSURE PIPE SADDLES	30
4.0	PIPE EMBEDMENT	31
4.1	BEDDING	31
4.2	BACKFILLING AND TAMPING	31
4.2.1	HAUNCHING AND INITIAL BACKFILL	32
4.3	COMPLETING THE BACKFILL	33
4.3.1	FINAL BACKFILL	33
4.4	COMPACTION METHODS	34
4.4.1	TAMPING BARS	34
4.4.2	MECHANICAL TAMPERS	35
4.4.3	FLOOD OR WATER TAMPING	36
4.4.4	WATER-JETTING	36
4.4.5	SHEETING AND TRENCH BOXES	36
5.0	PIPE TESTING AND REPAIR	37
5.1	PIPE DEFLECTION	38
5.1.1	DEFLECTION TESTING	38
5.2	TESTING WATER PIPE	37
5.2.1	FILLING THE LINE	39
5.2.2	RELIEVING AIR FROM THE LINE	40

5.3 PRESSURE-STRENGTH TESTS 40
5.4 MAKING LEAKAGE TESTS 41
5.5 MAKING REPAIRS TO DAMAGED PIPELINES 41

ELECTRICAL CONDUIT

CONTENTS

1.0 SOLVENT-CEMENTING JOINTS FOR PVC RIGID NONMETALIC
CONDUIT, DUCT AND FITTINGS 43

1.1 TO PRIME OR NOT TO PRIME? 43

1.2 SELECTION OF SOLVENT CEMENT 43

1.3 STORAGE OF SOLVENT CEMENT 43

1.4 CUTTING CONDUIT OR DUCT 44

1.5 CLEANING 44

1.6 APPLICATION PROCEDURE 45

1.7 ASSEMBLY PRECAUTIONS 45

1.8 ATMOSPHERIC CONSIDERATIONS 46

APPENDIX 1 47

TABLE A1.1 49

TABLE A1.2 51

THE PHYSICAL (OR CHEMICAL) PROPERTIES OF JM EAGLE™ SOLVENT WELD PVC AND ABS PIPE PRESENTED IN THIS BOOKLET, REPRESENT TYPICAL VALUES OBTAINED IN ACCORDANCE WITH ACCEPTED TEST METHODS AND ARE SUBJECT TO NORMAL MANUFACTURING VARIATIONS. THEY ARE SUPPLIED AS A TECHNICAL SERVICE AND ARE SUBJECT TO CHANGE WITHOUT NOTICE. CHECK WITH JM EAGLE™ PRODUCT ASSURANCE TO ENSURE CURRENT INFORMATION.

HOW THIS GUIDE CAN HELP YOU

This booklet was written especially for the installer and those who direct the actual handling and installation of JM Eagle™ Solvent Weld PVC and ABS Pipe. This guide should be used in conjunction with the following industry-accepted installation and testing practices that are applicable. This document should not be considered a full guide or manual in lieu of:

1. ASTM D2774-04 (or later) "Underground Installation of Thermoplastic Pressure Piping."
2. ASTM F690-86 (2003) (or later) "Underground Installation of Thermoplastic Pressure Piping Irrigation Systems."
3. ASTM F1668-96 (2002) (or later) "Construction of Buried Plastic Pipe."
4. ASTM F645-04 (or later) "Selection, Design, and Installation of Thermoplastic Water-Pressure Piping Systems."
5. ASTM D2321-05 (or later) "Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications."
6. ASTM D2564-02 "Solvent Cements for (PVC) Plastic Piping Systems."
7. ASTM D2235-01 "Solvent Cements for (ABS) Plastic Pipe and Fittings."
8. ASTM D2855-96 "Standard Practice for Making Solvent-Cemented Joints With (PVC) Pipe and Fittings."
9. ASTM F402-93 (1999) "Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings."

10. ASTM F656-02 “Primers for Use in Solvent Cement Joints of (PVC) Plastic Pipe and Fittings.”
11. ASTM F481-97 (2002) “Installation of Thermoplastic Pipe and Corrugated Tubing in Septic Tank Leach Fields.”
12. AWWA C605 “Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.”
13. AWWA C651 “Disinfecting Water Mains.”
14. AWWA M23 “PVC Pipe – Design and Installation.”
15. Uni-Bell® UNI-PUB-09 “Installation Guide for PVC Pressure Pipe.”
16. Uni-Bell® UNI-TR-1 “Deflection: The Pipe/Soil Mechanism.”
17. Uni-Bell® UNI-TR-6 “PVC Force Main Design.”
18. Uni-Bell® UNI-TR-7 “Thermoplastic Pressure Pipe Design and Selection.”

This guide is meant as an explanatory supplement to the materials above on how to install JM Eagle™ Solvent Weld PVC and ABS Pipe under normal or average conditions so as to comply with Standard JM Eagle™ Laying Specifications. Any discrepancies between the above standards and the written information contained herein should be brought to the attention of JM Eagle™ Product Assurance immediately for resolution by JM Eagle™, prior to any actions by either contractor, engineer or municipality.

This guide is not intended to supply design information nor to assume the responsibility of the engineer (or other customer representative) in establishing procedures best suited to individual job conditions so as to attain satisfactory performance.

Engineers, superintendents, contractors, foremen and laying crews will find much to guide them. This booklet will also be of help in determining pipe needs when ordering.

WARRANTY

J-M Manufacturing Company Inc. (JM Eagle™) warrants that its standard polyvinyl chloride (PVC), polyethylene (PE), conduit/plumbing/solvent weld and Acrylonitrile-Butadiene-Styrene (ABS) pipe products (“Products”) are manufactured in accordance with applicable industry specifications referenced on the Product and are free from defects in workmanship and materials. Every claim under this warranty shall be void unless in writing and received by JM Eagle™ within 30 days of the date the defect was discovered, and within one year of the date of shipment from the JM Eagle™ plant. Claims for Product appearance defects, such as sun-bleached pipe, etc., however, must be made within 30 days of the date of the shipment from the JM Eagle™ plant. This warranty specifically excludes any Products allowed to become sun-bleached after shipment from the JM Eagle™ plant. Proof of purchase with the date thereof must be presented to the satisfaction of JM Eagle™, with any claim made pursuant to this warranty. JM Eagle™ must first be given an opportunity to inspect the alleged defective Products in order to determine if it meets applicable industry standards, if the handling and installation have been satisfactorily performed in accordance with JM Eagle™ recommended practices and if operating conditions are within standards. Written permission and/or a Return Goods Authorization (RGA) must be obtained along with instructions for return shipment to JM Eagle™ of any Products claimed to be defective.

The limited and exclusive remedy for breach of this Limited Warranty shall be, at JM Eagle’s sole discretion, the replacement of the same type, size and like quantity of non-defective Product, or credits, offsets or combination of thereof, for the wholesale purchase price of the defective unit.

This Limited Warranty does not apply for any Product failures caused by user’s flawed designs or specifications, unsatisfactory applications, improper installations, use in conjunction with incompatible materials, contact with aggressive chemical agents, freezing or overheating of liquids in the Product, and any other misuse causes not listed here. This Limited Warranty also excludes failure or damage caused by fire stopping materials, tread sealants, plasticized vinyl products or damage caused by the fault or negligence of anyone other than JM Eagle™, or any other act or event beyond the control of JM Eagle™.

JM Eagle's liability shall not, at any time, exceed the actual wholesale purchase price of the Product. The warranties in this document are the only warranties applicable to the Product and there are no other warranties, expressed or implied. This Limited Warranty specifically excludes any liability for general damages, consequential or incidental damages, including without limitation, costs incurred from removal, reinstallation, or other expenses resulting from any defect. IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE SPECIFICALLY DISCLAIMED AND JM EAGLE™ SHALL NOT BE LIABLE IN THIS RESPECT NOTWITHSTANDING JM EAGLE'S ACTUAL KNOWLEDGE OF THE PRODUCT'S INTENDED USE.

JM Eagle's Products should be used in accordance with standards set forth by local plumbing and building laws, codes or regulations and the applicable standards. Failure to adhere to these standards shall void this Limited Warranty. Products sold by JM Eagle™ that are manufactured by others are warranted only to the extent and limits of the warranty of the manufacturer. No statement, conduct or description by JM Eagle™ or its representative, in addition to or beyond this Limited Warranty, shall constitute a warranty. This Limited Warranty may only be modified in writing signed by an officer of JM Eagle™.

SOLVENT WELD

1.0 RECEIVING AND HANDLING PIPE SHIPMENTS



Figure 1

1.1 INSPECTION

Each pipe shipment shall be inspected with care upon its arrival. Each pipe shipment is carefully loaded at the factory using methods acceptable to the carrier. The carrier is then responsible for delivering the pipe as received from JM Eagle™. All shipments include an adequate amount of lubricant for the pipe and a short form installation guide. IT IS THE RESPONSIBILITY OF THE RECEIVER TO MAKE CERTAIN THERE HAS BEEN NO LOSS OR DAMAGE (including smoke) UPON ARRIVAL.

Check the materials, pipe, gaskets and fittings received against the bill of lading (tally sheet that accompanies every shipment) in accordance with the general guidelines on the next page, reporting any error or damage to the transportation company representative and have proper notation made on the delivery receipt and signed by the driver. Present the claim in accordance with the carrier's instructions. Do not dispose of any damaged material. The carrier will advise you of the procedure to follow in order to procure samples and report the incident.

1. MAKE OVERALL EXAMINATION OF THE LOAD. If the load is intact, ordinary inspection while unloading should be enough to make sure pipe has arrived in good condition.
2. IF LOAD HAS SHIFTED OR SHOWS ROUGH TREATMENT, THEN EACH PIECE MUST BE CAREFULLY INSPECTED FOR DAMAGE.
3. CHECK THE TOTAL QUANTITIES OF EACH ITEM AGAINST THE TALLY SHEET (pipe, fittings, lubricant, etc.).
4. ANY DAMAGED OR MISSING ITEMS MUST BE NOTED ON THE DELIVERY RECEIPT AND RETURNED TO THE TRANSPORTATION COMPANY.
5. NOTIFY CARRIER IMMEDIATELY AND MAKE CLAIM IN ACCORDANCE WITH THEIR INSTRUCTIONS.
6. DO NOT DISPOSE OF ANY DAMAGED MATERIAL. Carrier will notify you of the procedure to follow.
7. SHORTAGES AND DAMAGED MATERIALS ARE NOT AUTOMATICALLY RESHIPPED. If replacement material is needed reorder through your distributor and make them aware of the claim.

1.2 UNLOADING



Figure 2

JM Eagle™ Solvent Weld PVC and ABS Pipe is lightweight and may be unloaded by 1. Hand, either by passing over the side or off the truck ends. Sliding one length on another is standard practice in unloading PVC pipe, but lengths in the bottom layer should be lifted off of the rough surface of the truck body to avoid abrasion. 2. Compact shipping units (palletized

bundles in a wood frame) for large orders of pipe. Conventional forklifts can unload these units quickly and easily. Care shall be exercised to avoid impact or contact between the forks and the pipe. The means by which JM Eagle™ Solvent Weld PVC and ABS Pipe is unloaded in the field is the decision and responsibility of the customer. Preferred unloading is in units using mechanical equipment such as forklifts, cherry pickers or front-end loaders with adequate forks and trained, competent operators. When unloading units, the following instructions should be carefully followed. Remove only one unit at a time.

1. Remove restraints from the top unit loads. These may be either tie-down straps, ropes, or chains with protection.
2. If there are boards across the top and down the sides of the load that are not part of the pipe packaging, remove them.
3. Use a forklift (or front-end loader equipped with forks) to remove each top unit one at a time from the truck. Remove back units first. Do not run the forks too far under the unit as fork ends striking adjacent units may cause damage. Do not let forks rub the underside of pipe to avoid abrasion.
4. If a forklift is not available, a crane or front-end loader may be used to unload the pipe. We recommend employing a spreader bar with synthetic straps rated for the load. The straps should be placed approximately 8 feet apart and looped under the load. Cables may be used in place of synthetic straps if they are protected by a rubber hose sleeve to prevent damage to the pipe.
5. DO NOT:
 - a) Handle units with chains or single cables.
 - b) Attach cables to unit frames for lifting.
6. During the removal and handling, be sure that the units do not strike anything. Severe impact could damage the pipe (particularly during cold weather).
7. Units should be stored and placed on level ground. Units should be protected by dunnage in the same way they were protected while loaded on the truck. The dunnage must support the weight of all units so that pipe lengths do not carry the weight of the unit loaded above them. Units should not be stacked more than two high.
8. To unload lower units, repeat the above unloading process (items 1 through 7).

WARNING: PVC pipe, though lighter than other material, is still heavy and may be dangerous if not handled properly. Not adhering to the instructions at left may result in serious injury to pipe, property and/or people. Do not stand or climb on units. Stand clear of pipe during unloading.

NOTICE: Pipe at the bottom of a stack may become out-of-round due to the weight of the material above it. At normal application temperatures this corrects itself soon after the load is removed due to the property of elastic memory. Under freezing conditions, this recovery to full initial roundness may take several hours.

1.3 COLD-WEATHER HANDLING

As the temperature approaches and drops below freezing, the flexibility and impact resistance of PVC and ABS pipe is reduced. Extra care should be used in handling during cold weather to avoid any type of impact to the pipe to prevent damage.

1.4 STOCKPILES

Store pipe on a flat surface so as to support the barrel evenly, with bell ends overhanging. If mechanical equipment is being used for handling, the unit bearing pieces provide an excellent base. If unloading by hand, secure two timbers for a base. Set them on a flat area spaced the same as a factory load. Nail chock blocks at each end. Build up the stockpile in the same manner, as it was stacked for shipment, transferring dunnage and chock blocks from load to stockpile. Store random lengths separately where they will be readily available. Individual lengths of pipe should be stacked in piles no higher than 5 feet. Solvent cements should be stored in tightly sealed containers away from excessive heat.

It should be noted that when PVC pipe is stored outside and exposed to prolonged periods of sunlight, an obvious discoloration or UV degradation of pipe could occur. Based on the 24-month weathering study, the performance of PVC pipe was equally impressive. No significant changes in tensile strength at yield was observed. Reductions in impact strength were apparent after two years of exposure to weathering and ultra violet radiation. However, consider-

ing PVC pipe's high-initial-impact strength, the reductions were not significant enough to warrant concern. Pipe breakage due to impact loads encountered during normal handling and installation is not a problem with PVC pipe. This UV degradation does not continue after the pipe is removed from UV exposure.

A method of protecting pipe during long exposures (several months) to sunlight is to cover it with canvas or other opaque material. Clear plastic sheets are not satisfactory. Allow for adequate air circulation between the cover and the pipe. This will prevent heat build-up and possible dimensional distortion. Solvent cements should be stored in accordance with ASTM F402 "Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners used for joining Thermoplastic Pipe and Fittings."

1.5 LOADING TRANSFER TRUCKS

Use trucks with long bodies so that pipe lengths do not over hang more than 2 feet. Make certain truck bed is smooth, without cross-strips, bolt heads, or other protrusions that could damage the pipe.

Place the first layer carefully with the bell ends overhanging. Avoid sliding the pipe and abrading it. Subsequent layers can be slid into place. All bell ends should overhang the layer below.

Short-body trucks may be used if fitted with racks that properly support the pipe in the horizontal position. The rack shall support the pipe with supports spaced every 3 feet or less along the pipe lengths. Pad the contact areas to avoid damage to the pipe.

1.6 DISTRIBUTING ALONG THE TRENCH

In stringing out pipe, keep these points in mind:

1. Line pipe as near to the trench as possible to avoid excessive handling. (Bell direction doesn't affect flow or hydraulic coefficients.)
2. If the trench is open, it is advisable to string pipe on the side away from excavated earth wherever possible, so that the pipe can be moved easily to the edge of the trench for lowering into position.

3. If the trench is not yet open, find out which side the excavated earth will be thrown; then string out on the opposite side (leave room for the excavator).
4. Place the pipe so as to protect it from traffic and heavy equipment. Also, safeguard it from the effect of any blasting that may be done.

2.0 TRENCH CONSTRUCTION

2.1 WORKING AHEAD OF THE PIPE LAYING CREW

Where soil and ground water conditions permit, long stretches of trench can be opened ahead of pipe laying, so as to take full advantage of the easy handling and speed of assembly of JM Eagle™ Solvent Weld PVC and ABS Pipe. However, as a general rule for most jobs, do not open the trench too far ahead of pipe laying. Avoiding these long stretches of opened trench may help with the economy of the project because:

1. It may reduce or even eliminate pumping or sheeting.
2. It minimizes the possibility of flooding the trench.
3. It reduces caving caused by ground water.
4. It helps avoid frozen trench bottom and backfill.
5. It reduces hazards to traffic and workers.

On most jobs, it will be desirable to keep excavating, pipe laying and backfilling close together.

2.2 CURVES IN THE TRENCH

The trench may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe as shown in [Table 1](#) on page 14.

PIPE SIZE (inches)	MINIMUM RADIUS (feet)	OFFSET (in)	PIPE SIZE (inches)	MINIMUM RADIUS (feet)	OFFSET (in)
0.5	12.5	247.11	3.5	87.5	27.55
0.75	18.75	141.70	4	100	24.08
1	25	101.47	6	150	16.02
1.25	31.25	79.53	8	200	12.01
1.5	37.5	65.56	10	250	9.61
2	50	48.65	12	300	8.00
2.5	62.5	38.73	14	350	6.86
3	75	32.19	16	400	6.00

* Offset based on 20-foot length of pipe forming a true arc.

Table 1

The line may be assembled above ground, in a straight line, and then curved when laid in the trench. All curvature results from the bending of the pipe lengths. There is no deflection allowed at the joint.

NOTICE: Mechanical means should not be employed to accomplish these radii. It is the intent that the workers should accomplish this manually in the trench. ON ½-INCH TO 16-INCH SOLVENT WELD PIPE, THE CURVE SHOULD BE ACCOMPLISHED BY BENDING THE PIPE RATHER THAN DEFLECTING THE JOINTS. THERE SHALL BE NO DEFLECTION IN THE JOINTS UPON COMPLETION TO AVOID OVER-STRESSING THE BELL OR FITTING AND PREVENT POSSIBLE BREAKAGE AND/OR LEAKS.

To avoid deflecting the joints while achieving curvature, it is recommended that the joints be sufficiently braced or backfilled and compacted to keep them stationary. Abrupt changes in direction may be accomplished with fittings.

2.3 TRENCH WIDTHS



Figure 3

Since JM Eagle™ Solvent Weld PVC and ABS Pipe can be assembled above ground and lowered into position, trench widths can be kept to a minimum. The trench width at the ground surface may vary with and depend upon depth, type of soils and position of surface structures. The minimum clear width of the trench, sheeted or unsheeted, measured at the spring-line of the pipe should be 1 foot greater than the outside diameter of the pipe. The maximum clear width of the trench at the top of the pipe should not exceed a width equal to the pipe outside diameter plus 2 feet. (See [Figure 3](#) above.) This spacing will allow for proper compacting of the backfill to provide necessary sidewall support. It will also allow assembly work in the trench, if desired. If the above defined trench widths must be exceeded or if the pipe is installed in a compacted embankment, pipe embedment should be compacted to a point of at least 2.5 pipe diameters from the pipe on both sides of the pipe or to the trench walls, whichever is less.

NOTICE: Since PVC pipe is a flexible pipe, trench width and shape have little to no effect on loading experienced by the pipe, since the maximum load that may be carried by the pipe is that due to the column of soil directly above the pipe outside diameter. The reason for the trench width recommendations above are to help installers realize the economies that may result from installation of PVC pipe over other materials, while maintaining adequate control over backfilling, compaction and placement to limit long-term deflection.

2.4 TRENCH DEPTHS

Depth is governed by surface loads, earth loads, and frost penetration. A minimum of 12 inches depth of cover is recommended where frost penetration need not be considered. Where frost is a factor, pipe should be buried 6 inches below the greatest recorded frost penetration. If the line will be drained and not used in winter, frost need not be considered.

Should unusual soil conditions and/or surface loads be anticipated and the engineer wants to calculate deflection when working with pressure pipes, “pipe stiffness” ($f/\Delta y$) can be found in [Table 2](#) below. For Schedule series pipe, please contact JM Eagle™ for assistance on calculating stiffness.

PIPE DR	STIFFNESS (psi)	PIPE DR	STIFFNESS (psi)
64	7	25	129
51	14	21	224
41	28	18	364
35	46	17	437
32.5	57	14	815
26	115	—	—

Table 2

For more information on deflection, see [Section 5.1](#).

2.5 PLANNING FOR THRUSTING

Fittings used for changes in direction and all in-line valves will require thrust blocking or restraints, which must be formed against a solid wall. Do not machine dig at these fitting areas because the excavator will usually dig too far and damage the bearing surface of the trench wall. A small amount of hand digging just behind the fitting location will ensure a solid trench wall for thrust block construction later on.

2.6 PREPARATION OF TRENCH BOTTOM

The trench bottom should be smooth and free from stones greater than 1.5 inches in diameter, large dirt clods, and any frozen material. Excavation at bells (bell holes) should be provided so that the pipe is uniformly supported along its length. (See [Figure 4](#) below.)

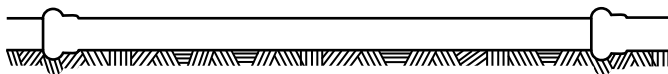


Figure 4

Generally, loose material left by the excavator on the trench bottom will be adequate for bedding the pipe barrel so that it is fully supported. Where the excavator cuts a very clean bottom, soft material can be shaved down from the sidewalls to provide needed bedding. If the trench bottom is rocky or hard, as in shale, place a 4-inch layer of selected backfill material to provide a cushion for the pipe. In rock excavation it is necessary that rock be removed and a bed of sand or selected backfill at least 4 inches deep be placed on the bottom of the trench to provide a cushion for the pipe. A pipeline of any material, which in the absence of a bedding cushion, rests directly on rock, is subject to breakage under the weight of the backfill load, surface load or earth movements.

When an unstable trench bottom is encountered and, in the opinion of the engineer, it cannot support the pipe, an additional depth should be excavated and refilled to the pipe grade with material approved by the engineer. Trenches can be dangerous and the contractor has the responsibility of ensuring that all safety regulations and design requirements have been observed for the protection of the workers and public.

3.0 PIPELINE CONSTRUCTION

3.1 INSPECTION

Pipe and accessories should be inspected for defects and cleanliness prior to lowering into the trench. Any defective, damaged or unsound material should be repaired or replaced and foreign matter or dirt should be removed from the interior of the pipe and accessories before lowering into the trench.

3.2 LOWERING PIPE AND ACCESSORIES INTO TRENCH

All pipe, fittings, valves and accessories should be carefully lowered into the trench using suitable equipment in such a manner as to prevent damage to pipe and accessories. PIPE AND ACCESSORIES SHOULD NEVER BE DROPPED OR DUMPED INTO THE TRENCH.

CAUTION: Heavy impact may cause a slight longitudinal indentation in the outside of the pipe and a crack on the inside. This will result in a split as soon as the pipe is placed under pressure. Any pipe that has been impacted should be examined closely for this type of damage.

3.2.1 SNAKING

To compensate for thermal movements when laying small diameter pipe it is recommended that the pipe be “snaked” or curved in the trench. Snaking is recommended for sizes of pipe less than 3 inches in diameter. For assistance with determining the adequate snaking lengths and offsets, consult [Table 3](#). For sizes 3-inch and larger, pipe should be installed in straight alignment. Prior to backfilling to the extent that longitudinal movement is restricted, the pipe temperature should be within 15 degrees F of the operating temperature of the pipe. [Figure 5](#) illustrates the principle of snaking and identifies the elements necessary to use in [Table 3](#).

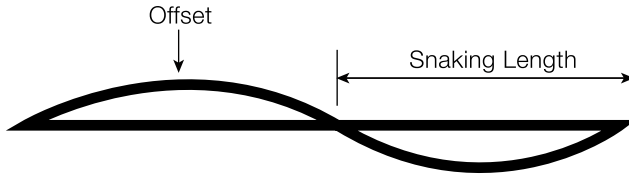


Figure 5

SNAKING LENGTH (feet)	MAXIMUM TEMPERATURE CHANGE IN DEGREES (F) BETWEEN CEMENTING AND BACKFILING									
	10	20	30	40	50	60	70	80	90	100
	APPROXIMATE LOOP OFFSET (inches)									
20	3	4	5	5	6	6	7	7	8	8
50	7	9	11	13	14	16	17	18	19	20
100	13	18	22	26	29	32	35	37	40	42

Table 3

3.3 ABOVE-GROUND INSTALLATION

When installing Solvent Weld products above ground it is important to provide adequate offsets to allow for movement of the pipe under thrust and thermal expansion.

The thermal expansion coefficient for PVC is 0.36 inches per 10 degrees F per 100 feet. For assistance in calculating the required offsets or expansion loops to accommodate a given temperature change or ABS information, please contact JM Eagle™ Product Assurance.

In some cases it may be required to have the pipe supported at evenly spaced intervals. The recommended support spacing for SCH 40 and 80 at 73 degrees F are presented in [Table 4](#). For all other pipe and temperatures, please consult JM Eagle™ Product Assurance for the appropriate table.

PVC SCH 40 AND 80 MIN. SUPPORT SPACING			
PIPE SIZE (inches)	SPACING (feet)	PIPE SIZE (inches)	SPACING (feet)
0.5	4.25	3	7.5
0.75	4.5	4	8.25
1	5	6	9.5
1.25	5.5	8	10.5
1.5	5.75	10	11.5
2	6.25	12	12.5

Table 4

When installing PVC pipe above ground, it is required that hangers supporting the pipe do not pinch or restrict the pipe from moving or abrade the pipe in any way. In addition, the hangers should be of sufficient width to avoid point loading on the pipe. Acceptable types of hangers include pipe clips, u-type clamps and roller carriers. Failure to accommodate pipe movement properly may result in leakage and/or damage to pipe, property, and/or people.

All local, state and federal codes and standards should be followed in addition to this guide when designing and installing Solvent Weld PVC and ABS Pipe. Extreme care should be exercised when installing Solvent Weld pipe above ground. Pipe should be protected from UV exposure, excessive heat or sub-freezing temperatures and impact. In addition, provisions should be made to release entrapped air.

WARNING: Failure to protect pipe from the environment may result in leakage, rupture and/or explosion. These may result in severe damage to pipe, property, and/or persons.

3.4 MAKING SOLVENT CEMENTED JOINTS FOR PVC AND ABS

The standard practice for making solvent cemented joints is outlined in ASTM D2855 “Standard Specification for Making Solvent-Cemented Joints with PVC Pipe and Fittings,” and should be reviewed prior to making any attempts to join PVC and/or ABS pipe. The following is a brief summary of the

detailed instructions presented in the fore mentioned standard.

1. Select the proper Solvent Cement and Primer (if needed) for your application per the outline below:

- PVC: PVC solvent cement must comply with ASTM D2564. Primer, if needed shall meet ASTM F656.
- ABS: ABS solvent cement must comply with ASTM D2235.
- For PVC to ABS transitions, solvent cement shall meet ASTM D3138. If system is intended for potable water, the primer and cement shall be ANSI/NSF STD-61 approved.

In addition, the following should be closely examined to ensure that the correct viscosity of cement is selected:

- Use clear, light-bodied cement (i.e.: #710) with SCH 40 fittings having an interference fit through 2 inches in size. Do not use with SCH 80 pipe.
- Use clear, medium-bodied cement (i.e.: #705) with SCH 40 fittings having an interference fit for sizes 2.5 to 6 inches. Do not use with SCH 80 pipe.
- Use gray heavy-bodied cement (i.e.: #711) with SCH 80 fittings up to 8-inches and SCH 40 fittings in the 6 and 8-inch size.
- Use gray, extra heavy-bodied cement (i.e.: #719) with SCH 40, 80, and all class or schedule sizes over 8 inches.

The above recommendations are for 73 degrees F. Primers are generally used in colder temperatures. During hot weather, cements may dry faster and thus higher viscosity cement than that listed above may need to be used to get extra working time. High-viscosity cements and higher wet-film thickness cements are not recommended for small diameter pipe, except in very cold, dry weather.

2. Condition the pipe and fittings at the same temperature before starting assembly.

3. Cut the pipe square to the desired length. A diagonal cut reduces the bonding area in the joint and may result in leakage. If tubing cutters are used, they will produce a raised bead that must be removed. A raised bead will wipe the solvent cement away when the pipe is joined.

4. Chamfer the pipe end, if needed. A factory bevel should be used as a guide to the length and angle of taper. Smaller sizes may not require

- a bevel (Figure 6A).
5. Clean and dry the pipe and fitting to remove all dirt, moisture, and grease. Always use a clean, dry rag (Figure 6B).
 6. Check the pipe and fitting for a dry fit before cementing (Figure 6C). For proper joining, the pipe must go one-third to three-fourths the distance to the fitting stop. Too tight of a fit is not desirable. You must be able to fully bottom the pipe into the socket after it has been softened. If the pipe and fittings are not completely round, a satisfactory joint can still be achieved with a “net” fit. This means that the pipe bottoms out into the fitting with no interference, but without too much play or wobble.
 7. In some cases, primers may need to be used to help prepare the material for bonding and fusing.
 8. Before any installation, it is recommended that the penetration and softening of a primer be checked on a scrap piece of the same lot of pipe. This should be done in the same environmental conditions as the actual installation. The effect of the primer will vary with time, temperature and humidity. To check for proper priming, apply the primer as indicated in Step 7. After primer is applied, use a knife or sharp scraper to scratch across the primed surface. If proper priming has been achieved, a few thousandths of an inch of material will be removed.
 9. Using the correct applicator, apply the primer to the inside of the socket first. Use a scrubbing motion and ensure that the applicator is wet until the surface has been softened (use the time measured above). Next, apply the primer in the same way to the spigot. Primer should only be applied to a depth that the fitting will go onto the pipe. Ensure that both the spigot and the socket are completely and well dissolved and softened. Ensure that all puddles of primer are removed from the pipe. Puddles of primer can weaken the pipe and/or joint, resulting in leakage, damage or injury.
 10. Immediately before primer dries, apply cement lightly but uniformly to the spigot end (Figure 6D). The amount of cement should be sufficient to fill any gaps between the pipe and fitting, without being excessive.
 11. Apply a medium layer of cement to the socket (Figure 6E). Do not apply cement beyond the socket depth or allow cement to run down past the socket depth to avoid weakening the pipe.
 12. While the socket and spigot are still wet with cement (a second coat may be required for the spigot, or on 3-inch and larger pipe, two men may be required), forcefully bottom the spigot into the pipe socket.

Twist the spigot one-quarter turn ([Figure 6F](#)). Hold joint tight and in straight alignment until surfaces are fused. Properly made joints will have a ring or bead of cement completely around the juncture of the spigot and socket. Gaps may indicate poor assembly, wrong grade or insufficient cement.

13. Without disturbing the joint, use a clean, dry rag to remove all excess cement. Excess cement may cause weakening of the pipe and additional cure time. Handle joint with care until initial set time has elapsed. Do not pressurize or test the line until the appropriate cure time has been achieved. See [Table 5](#) for recommended times.

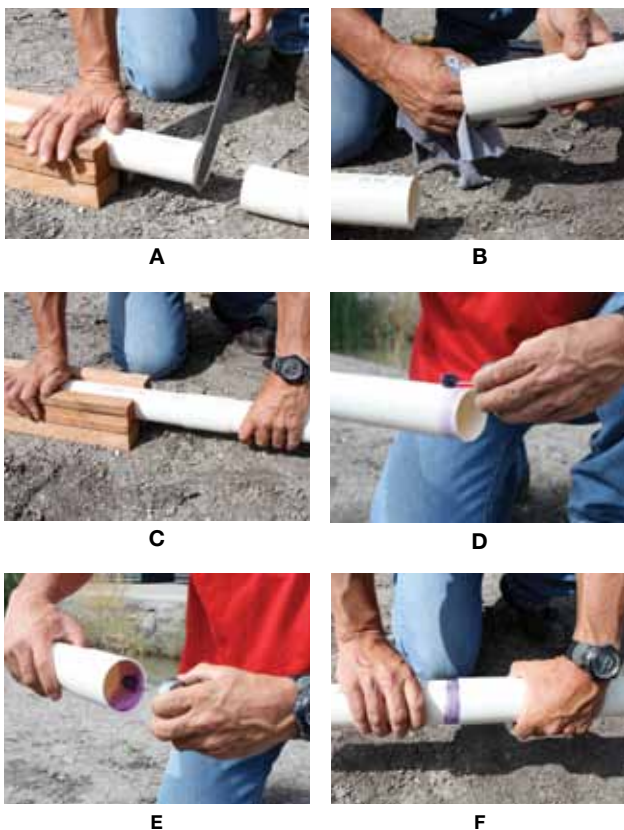


Figure 6

INITIAL SET TIME FOR 60% HUMIDITY OR LESS								
TEMPERATURE (F)	PIPE SIZE (inches)							
	0.5 - 1.25		1.5 - 3		4 - 8		10 - 14	16
60 to 100	15 min		30 min		1 hr		2 hr	4 hr
40 to 59	1 hr		2 hr		4 hr		8 hr	16 hr
0 to 39	3 hr		6 hr		12 hr		24 hr	48 hr
JOINT CURE TIME FOR 60% HUMIDITY OR LESS								
TEST PRESSURE (psi)	up to 180 (psi)	180 to 370 (psi)	up to 180 (psi)	180 to 315 (psi)	up to 180 (psi)	180 to 315 (psi)	up to 180 (psi)	up to 180 (psi)
TEMPERATURE (F)								
60 to 100	1 hr	6 hr	2 hr	12 hr	6 hr	24 hr	24 hr	48 hr
40 to 59	2 hr	12 hr	4 hr	24 hr	12 hr	48 hr	72 hr	5 d
0 to 39	8 hr	48 hr	16 hr	96 hr	48 hr	8 d	8 d	10 d

Table 5

The colder the weather, the greater the time required for the primer to etch the pipe and also for the joint to set up. P-70 primer and 717 have been used successfully at temperatures below zero; however, it is difficult to obtain good joints under these conditions and it is not recommended. The pipe and fittings should be heated to 40 degrees F or higher by means of light bulbs, catalytic heater, etc. During cold weather it may be necessary to apply two or more coats of primer. Check to see that both mating surfaces are etched and wet with primer before applying the cement.

WARNING: Keep primer and cement away from flame or excessive heat to avoid combustion or explosion. In addition, when assembling solvent weld saddles onto pipe, toxic fumes are given off. In confined areas sufficient concentrations of these fume may accumulate to cause nausea and/or dizziness.

To prevent toxic fume build-up, it is recommended that:

1. Pipe be assembled above ground where possible or in areas with good air circulation.
2. In confined areas with poor natural circulation, a blower should be used.
3. If the above installation environmental conditions are not practical or possible, respirators should be used. Respirators approved under the

Bureau of Mines Schedule 23 as manufactured by MSA, American Optical Corp, Welsh Mfg., etc., for protection against organic vapors have been found to be satisfactory.

3.5 CUTTING

A square cut is essential to ensure proper assembly and/or beveling. PVC and ABS pipe can easily be cut with a fine-toothed hacksaw, handsaw or a power-type saw with a steel blade or abrasive disc. (Do not use standard pipe cutters. The cutting wheel may crush or damage the pipe.) It is recommended that the pipe be marked around its entire circumference prior to cutting to ensure a square cut. Do not burn the pipe while cutting.



Figure 7

NOTICE: JM Eagle™ recommends using proper personal protective equipment, such as gloves and safety glasses, when cutting PVC pipe.

3.6 BEVELING

Use a factory-finished beveled end as a guide to determine the angle and length of taper. The end may be beveled using a plastic pipe-beveling tool as shown, which will cut the correct taper automatically or such tools as the Stanley “Surform” No.399, a coarse file or rasp. A portable sander or abrasive disc may also be used to bevel the pipe end. Remove all burrs and raised edges prior to assembly. Note that some smaller sizes of pipe are not

shipped with a factory bevel.

3.7 ASSEMBLY AT FITTINGS AND ADAPTORS

JM Eagle™ Solvent Weld PVC and ABS Pipe are generally manufactured with an IPS outside diameter. Some products have standard gravity sewer outside dimensions. This means that this pipe can be directly connected to IPS and/or Gravity Sewer OD products and fittings such as steel pipe accessories.

Additionally, cast iron fittings may be joined to the PVC pipe spigot ends by means of transition gaskets. Mechanical joint fittings may be joined to PVC pipe in sizes 4 inches through 16 inches by means of a transition gasket supplied by the fitting supplier.

No extra support need be provided for these fittings and adaptors, but any heavy metal fittings or valves must be individually supported to avoid differential settlement between fitting and pipe. Note that fittings and valves in-line will require thrust blocking as specified in [Section 3.8](#).

Fittings and adaptors are usually installed at predetermined locations and therefore, a tie-in length of less than 20 feet will usually be required.

1. Be sure the correct gasket is used with the bell or fitting.
2. Bevel on the spigot should approximate the cast iron bevel, which is shorter and steeper. The reason for this is that the depth of the bell or fitting is shorter than the PVC bell. The reduced length of taper will allow a greater flat sealing surface and minimize the possibility of the gasket seating on the bevel, which may cause leakage.
3. When connecting to a mechanical joint or flanged fitting, a beveled spigot is not recommended or required. Cut off beveled end of pipe prior to insertion into M-J style fitting.

NOTICE: If a backhoe or bar is used for any assembly, a wood plank should be placed between the pipe and the bucket to prevent damage.

3.8 THRUST BLOCKING AND ANCHORAGE AT FITTINGS

Thrust backing is needed wherever the pipeline:

1. Changes direction, as at tees, bends or crosses.
2. Changes in size, as at reducers.
3. Stops, as at dead ends.
4. Valves at which thrust develops when closed.

Where the piping system employs self-restraining joints (for example flanges, heat fusion, mechanical joint restraint or solvent cement joints) at these points in the system, thrust blocking shall not be required for thrust restraint.

3.8.1 DETERMINING SIZE AND TYPE OF THRUST BLOCKING

Size and type of blocking depends on pressure, pipe size, kind of soil and type of fitting. Common thrust block configurations are shown in [Figure 8](#). At vertical bends, anchor pipelines to resist outward or horizontal thrusts as shown in [Figure 9](#). If thrusts due to high pressure are expected, anchor the valves as shown in [Figure 10](#). In all cases, thrust blocking and anchorages should be designed by a competent engineer to ensure adequate safety and support based on the actual field conditions encountered. Failure to design thrust blocking and anchorage adequately may result in damage to the pipe, property and/or people.

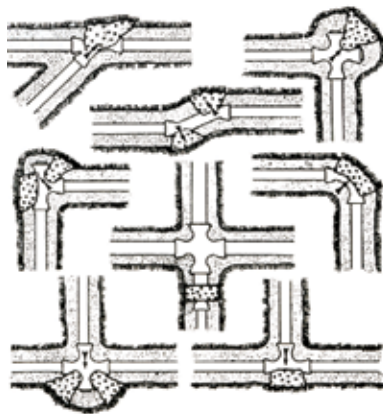


Figure 8

In soft, unstable soils such as muck or peat, thrusts are resisted by running corrosion-resistant tie rods to solid foundations or by removing the soft material and replacing it with a ballast of sufficient size and weight to resist the thrusts developed.

Pre-cast thrust blocks should not be placed directly against PVC pipe to avoid point loading and provide adequate force distribution.

3.8.2 UPWARD THRUSTS AT FITTINGS

Where a fitting is used to make a vertical bend, anchor the fitting to a thrust block braced against undisturbed soil. The thrust block should have enough resistance to withstand upward thrusts at the fitting. See [Figure 9](#).

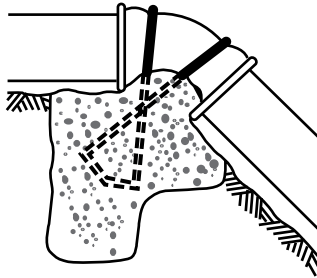


Figure 9

3.8.3 ANCHORAGE OF PIPE ON SLOPES

Anchors on slopes are needed only when there is the possibility of back-fill slipping downhill and carrying the pipe with it. Usually, well-drained soil, carefully tamped in 4-inch layers up to the top of the trench, will not slide and pipe anchors will not be required.

Where soil slippage is a possibility, anchors keyed in undisturbed soil can be fastened to every other length of pipe.

3.8.4 ANCHORAGE OF VALVES IN THE LINE

Under pressure conditions, valves must be anchored as shown in [Figure 10](#) against the thrust created when the valve is closed. The area of undisturbed soil, which braces the thrust block, must be large enough to withstand the thrust in whatever direction it is exerted.

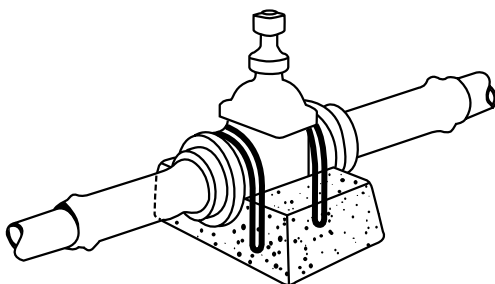


Figure 10

3.8.5 CONSTRUCTION OF THRUST BACKING

1. Concrete thrust blocks are constructed by pouring concrete between the fitting and the undisturbed bearing wall of the trench. A dry mixture is prepared so that the concrete may be easily shaped into the desired form, a wedge with the wide end against the solid wall. Note the shapes and positions of the thrust blocks in the drawings.
2. Cinder blocks, wood, dry sand-cement mix or other materials may be used for pipe sizes less than 6 inches provided that (a) there is sufficient bearing area between backing and fitting, and (b) the backing has sufficient strength to withstand the thrust load. If wood is used it must be treated to prevent deterioration.
3. As an alternative, mechanical thrust restrainers may be used to resist the thrust developed.

3.9 THRUST-RESTRAINT JOINTS OF SOLVENT WELD PIPE

Solvent Weld joints are rigid joint connections and usually do not require any additional restraint against thrust. In the event that the restraint provided by the joint is not sufficient to withstand the thrust generated, various types of additional thrust-restraint devices are currently promoted for use with PVC pipe. These include couplings, which require grooving the pipe and various fittings with set screws that bear on the pipe wall. These devices can be uniformly recommended by JM Eagle™ for use with our products. For installation, follow the recommendation of the device manufacturer.

3.10 SERVICE CONNECTIONS

Service connections may be made to JM Eagle™ Solvent Weld PVC Pressure Pipe by means of a saddle or a sleeve and valve in the line at the service location. Due to the in-depth knowledge required to make proper taps safely, please refer to Uni-Bell® Publication UNI-PUB-08-07, “Tapping Guide for PVC Pressure Pipe,” to give detailed information with regard to tapping. Please contact JM Eagle™ Product Assurance to obtain a complete hard copy of this guide prior to tapping any JM Eagle™ Pressure Product. For making connections to DWV pipe, please consult JM Eagle™ Publication JME-05B “Gravity Sewer Installation Guide.”

3.10.1 PRESSURE PIPE SADDLES

With saddle connections, a JM Eagle™ Solvent Weld PVC Pressure Pipe pipeline can be tapped before or (after) the line goes into service. Check with saddle manufacturers for recommended pressure rating of saddles used.

WARNING: Use of improper tapping procedures or tools may result in serious damage to pipe, property and/or people. Do not tap prior to obtaining the complete tapping guide.

4.0 PIPE EMBEDMENT

Below is an illustration of a typical trench with all major regions identified as they will be addressed in the following sections.

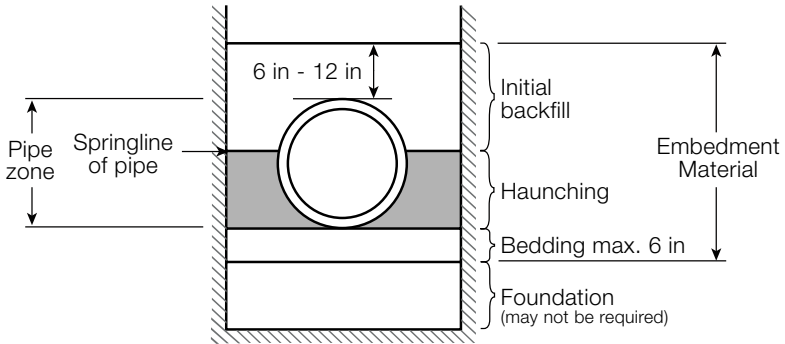


Figure 11

4.1 BEDDING

Bedding is required primarily to bring the trench bottom up to grade. Bedding materials should be placed to provide uniform longitudinal support under the pipe to prevent low spots. Blocking should not be used to bring the pipe to grade. Bell holes at every joint will allow for the joint to be assembled properly and maintain adequate support. Under normal circumstances, a bedding of 4 to 6 inches compacted is of sufficient thickness for the bedding. If the native trench soil is comprised of fine grain soils and migration of those soils into the bedding material is anticipated, either wide trench construction, a well-graded bedding material without voids or a fabric barrier should be used to avoid compromising the trench backfill materials.

4.2 BACKFILLING AND TAMPING

Backfilling should follow pipe assembly as closely as possible. This protects the pipe from falling rocks, eliminates the possibility of lifting the pipe from grade due to flooding of an open trench, avoids shifting pipe out of line by cave-ins, and in cold weather, lessens the possibility of backfill material be-

coming frozen.

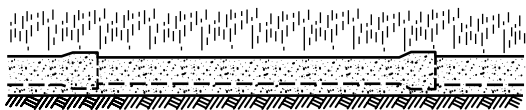
4.2.1 HAUNCHING AND INITIAL BACKFILL

There are two basic purposes of the haunching and initial backfilling of a flexible conduit such as PVC pipe:

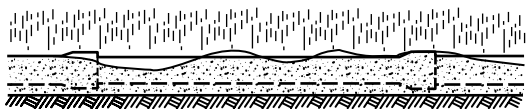
1. To provide the soil side support, which is necessary to enable the pipe and the soil to work together to meet the designed load requirements within the allowable deflection limits.
2. To provide protection for the pipe from impact damage due to large rocks, etc., contained in the final backfill.

The essentials of satisfactory haunching and initial backfilling can be summarized as follows: Provide approved materials, properly compacted continuously above the bedding and around the pipe to the spring-line between the pipe and undisturbed trench walls.

After the bedding material has been placed according to [Section 4.1](#), place the haunching and initial backfill by hand to a 1-foot minimum depth of cover above the pipe to give pipe support and cushion. In doing so, proper control should be exercised to avoid vertical and horizontal displacement of the pipe from proper alignment. This backfill should be a selected material, free from rocks greater than 1.5 inches in diameter, dirt clods or frozen material. This material is solely responsible for providing effective support of the pipe in the haunching area and limiting deflection. This is accomplished by tamping the embedment materials under the haunches and around the pipe to the spring-line of the pipe.



A. **Right** — Backfill correctly placed by hand filling all voids.



B. **Wrong** — Backfill not placed evenly.

Figure 12

Side support is accomplished by tamping the soil firmly under the haunches of the pipe out to the trench walls. Tamping should be done in layers no greater than 6 inches. If automatic tampers are used, care should be exercised to avoid damaging the pipe. For more information on tamping, see [Section 4.4.1](#).

The immediate placement of initial backfill will provide adequate weight of soil on the pipe so that expansion and contraction will be evenly distributed over each pipe length. This portion of the backfill begins at the spring-line of the pipe and extends to some predetermined distance above the pipe. Since little to no side support is derived from the soils placed in this area, native soils may be used without tremendous compaction efforts, unless in the influence zone of other structures. It should be noted that at shallow depths of cover (less than 3 feet) flexible conduits may deflect and rebound under dynamic loading if the trench width is not highly compacted, resulting in damage to road surfaces. For pipes buried under flexible road surfaces at depths less than 3 feet, it is recommended that a minimum of 90 percent Proctor density be achieved from the bottom of the trench up to the road surface using Class I or Class II materials as described in [Appendix 1](#). Minimum cover is recommended to be 1-foot from the top of rigid road surfaces or the bottom of flexible road surfaces.

NOTICE: For water pipe installations the top area of the bells can be left exposed for visual inspection during the test if required.

4.3 COMPLETING THE BACKFILL

Balance of backfill need not be as carefully selected as the initial material, unless specified by the engineer. Care should be taken, however, to avoid including large stones that could damage the pipe by dropping on it or by being forced down on to the pipe under the weight of the final backfill.

4.3.1 FINAL BACKFILL

The final backfill should be placed and spread in uniform layers in such a manner as to completely fill the trench with a uniformly dense backfill load on

the pipe and avoid unfilled spaces in the backfill. Rolling equipment should not be used until a minimum of 18 inches of backfill material has been placed over the top of the pipe. If a hydro hammer is to be used to compact the backfill, a minimum of 3 feet of cover is required. Unless otherwise specified, trenches under pavements, sidewalks or roads shall be backfilled and compacted to 90 percent density, as determined by the [American Association of Highway and Transportation Officials Method T99 for State Compaction and Density of Soils](#). Unless specified, other trenches may be backfilled without controlled compaction in the final backfill. Additional backfill material should be supplied, if needed, to completely backfill the trenches or to fill depressions caused by subsequent settlement.

For description of backfill materials and their recommended usage, please refer to [Appendix 1](#).

4.4 COMPACTION METHODS

The first step in providing effective support for the pipe in the haunching area is to tamp the embedment materials under the haunches and around the pipe to the spring-line of the pipe.

Tamping should be done with hand tamping bars, mechanical tampers or by using water to consolidate the embedment materials. With hand tamping, satisfactory results can be accomplished in damp, loamy soils and sands. For more cohesive soils, the necessary compaction may require the use of mechanical tampers. Water tamping should be limited to trenches excavated in soils in which water drains through quickly and, in so doing, compacts the embedment material.

4.4.1 TAMPING BARS

Two types of tamping bars should be available for a good tamping job. The first should be a bar with a narrow head. (See [A](#) or [B](#) of [Figure 13](#).) These are used to tamp under the pipe. The second tamping bar should have a flat head. It is used to compact the soil along the sides of the pipe to the trench walls. (See [Figure 13C](#).)

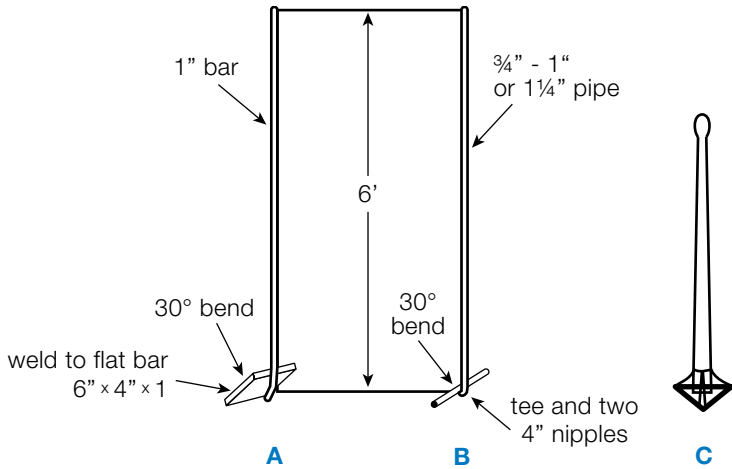


Figure 13

Do not attempt to use the flat tamper (C) in place of A or B.

4.4.2 MECHANICAL TAMPERS

Care should be taken to avoid contact between the pipe and compaction equipment. Compaction of the embedment material should generally be done in such a way that the compaction equipment is not used directly above the pipe until sufficient backfill has been placed to ensure that the use of compaction equipment will not damage the pipe or cause deflection of the pipe.

When hydro-hammers are used to achieve compaction, they should not be used within three feet of the top of the pipe and then only if the embedment material density has been previously compacted to a minimum 85 percent Proctor density.

4.4.3 FLOOD OR WATER TAMPING

Flooding or water tamping should be used only in trenches that are excavated in soils from which water drains quickly and, at the same time, compacts the haunching material. If flooding is used, the approved embedment material is first hand placed, making certain all voids under, around and along both sides of the pipe and couplings are filled. Initial embedment material should be placed to a height sufficient to prevent floating of the pipe.

4.4.4 WATER-JETTING

The introduction of water under pressure to the embedment material is not to be used to compact the embedment material of PVC pipe, or any other flexible conduit.

When installing JM Eagle™ Solvent Weld Under-Drain Pipe (ASTM D2729), please follow ASTM F481 “Standard Practice for Installation of Thermoplastic Pipe and Corrugated Tubing in Septic Tank Leach Fields.”

4.4.5 SHEETING AND TRENCH BOXES

When sheeting is used, it should be left in place unless it is designed to prevent disturbing the soil adjacent to the pipe when pulled and removed. If heavy wooden sheeting has to be pulled, well-graded granular material should be placed on each side of the pipe for a distance of at least two pipe diameters. The granular material should be compacted to at least 90 percent Standard Proctor density.

Whenever possible, sheeting and bracing should be installed so that the bottom of the sheeting extends no lower than the spring-line of the pipe. When installed in this manner, pulling the sheeting will not disturb the embedment material providing sidewall support for the pipe. If a trench box is used, it should be designed so that the backend of the sides do not extend below the pipe spring-line. This will allow filling and compaction of the annular space as the trench box is moved forward.

5.0 PIPE TESTING AND REPAIR

5.1 PIPE DEFLECTION

Under ordinary circumstances the deflection of PVC pressure pipe is of no concern because the internal pressure of the pipe is much greater than the external load placed on the pipe, thus no deflection occurs. However, in some cases these pipes are used for force mains or gravity flow applications. Towns and municipalities normally set the long-term deflection limits of PVC at 7.5 percent by ASTM D3034 (Appendix), to provide a very conservative factor of safety against structural failure. However, it should be noted that PVC sewer pipe will have a minimum safety factor of 4 in structural failure at this limit. To ascertain how a certain PVC product will deflect under various loading conditions, backfill types and depths, one may contact JM Eagle™ for design charts specific to a situation.

5.1.1 DEFLECTION TESTING

It is the position of JM Eagle™ that deflection testing of PVC pipe is unnecessary when pipe is installed in accordance with the acceptable practices stated in this guide. Most towns and municipalities limit initial deflection to 5 percent, when in actuality ASTM D3034 recommends PVC pipe deflection at 7.5 percent of base inside diameter. Thus, exceeding these limits does not necessarily indicate any structural damage, failure or reduction in life and only adds to the cost of the project. Proof of this position is that more than 750 million feet of PVC sewer pipe are performing satisfactorily in the field today. On the other hand, where improper installation practices are known or suspected, questionable bedding materials are employed, and/or installation conditions are severe, deflection testing of these sections of the installation should be considered advisable by the engineer. In the event that deflection measurement is a requirement, please consult JM Eagle™ Publication JME-05B, “Gravity Sewer Installation Guide.”

5.2 TESTING WATER PIPE

It is good practice to pressure test portions of a line as it is installed—before

the entire line is completed. Before testing, all parts of the line should be backfilled and braced sufficiently to prevent movement under pressure. In setting up a section of line for test, a provision for air relief valves should be made.

There are three parts of the line to consider when testing:

1. The run of pipe, which must be backfilled sufficiently to prevent movement under test pressure.
2. Thrust blocks at fittings, which should be permanent and constructed to withstand test pressure. If concrete thrust blocks are used, enough time to permit the cement to set must elapse before testing.
3. Test ends, which should be capped and braced to withstand the appreciable thrusts that are developed under test pressure. Refer to [Section 3.8 on “Thrust Blocking and Anchorage at Fittings.”](#)

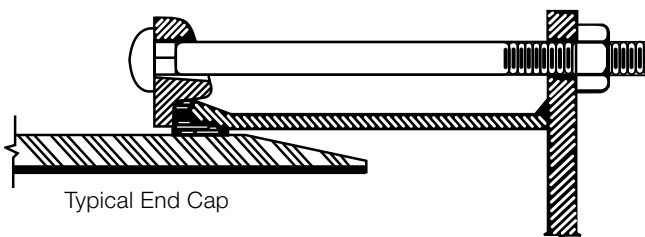


Figure 14

The last full-length laid should be firmly wedged and braced to prevent kicking out under pressure. (All exposed pipe must be wedged or backfilled, in order to hold it securely in line.) Using a plumb bob over a reference point on the pipe will check creeping when pressure is built up.

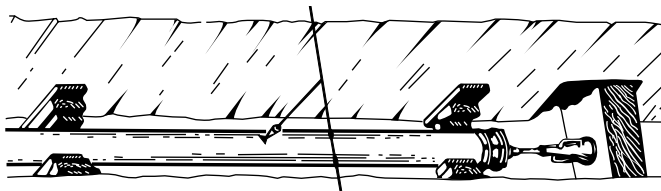


Figure 15

5.2.1 FILLING THE LINE

The line can be slowly filled from any available low-pressure source. The water can be introduced from lines in service through valve connections, by temporary connections to hydrants, to taps made in the new line, or at the connection in the end cap. All such connections, however, should be made at the lowest point in the line, if possible, to help eliminate air entrapment. Where a portion of the line is to be tested and has not yet been tied to the final source, some other source of water must be found. The following [Table 6](#) shows the approximate volume of water required for filling JM Eagle™ Solvent Weld PVC and ABS Pipe. For all pipe sizes and classes not included in the following chart, please contact JM Eagle™ or consult JM Eagle™ Publication JME-06B, “I.P.S. Pressure and Irrigation Pipe Installation Guide.”

VOLUME OF WATER REQUIRED IN GALLONS/FOOT		
PIPE SIZE (inches)	PIPE SCHEDULE	
	40	80
1.5	0.10	0.09
2	0.17	0.15
2.5	0.24	0.21
3	0.38	0.33
4	0.65	0.58
6	1.48	1.33
8	2.57	2.33
10	4.06	3.68
12	5.77	5.20
14	6.97	—
16	9.11	—

Table 6

5.2.2 RELIEVING AIR FROM THE LINE

ALL AIR SHOULD BE VENTED FROM HIGH SPOTS IN THE PIPELINE BEFORE MAKING EITHER PRESSURE OR LEAKAGE TESTS. AUTOMATIC AIR RELEASE VALVES ARE RECOMMENDED. Compressed entrapped air causes difficulty in pumping to required pressure for strength tests. Furthermore, a pipeline may leak compressed air when it is actually watertight. If this occurs during a leakage test, it will cause erroneous results. Most importantly, when entrapped air is compressed, it poses a severe explosion hazard and may result in pipe failure and/or injury to property and/or persons. Don't use PVC for compressed-air systems.

5.3 PRESSURE-STRENGTH TESTS

The purpose of a pressure-strength test is to make certain that the line will withstand normal working pressure plus reasonable excesses that may occur. In a properly designed line, excess pressures will be kept to a minimum by the use of automatic relief valves, slow closing and opening valves, slow pump starting and other controls. A test pressure of 25 percent above the normal operating pressure should generally be sufficient, unless the specification calls for greater pressure. Do not build test pressures greater than those specified. This can happen if the pressure is read from a gauge located at a high point in the line. In such cases the actual pressure at low points will be greater and might cause damage to the line. In all cases, it is important that no pressure test, regardless of duration, exceed the marked pressure capacity of the pipe and/or accessories being tested. Doing so might cause damage to the line or shorten the expected life of the system. For more detailed instructions on how to perform installation and pressure testing, please consult [ASTM D2774](#), “Standard Practice for Underground Installation of Thermoplastic Pressure Piping.”

5.4 MAKING LEAKAGE TESTS

The purpose of a leakage test is to establish that the section of line to be tested—including all joints, fittings, and other appurtenances—will not leak or that the leakage established is within the limits of the applicable leakage allowance. Leakage, if any, is usually involved in joints at saddles, valves, transition fittings and adaptors and not usually in pipe joints. Normal operating pressure is usually applied for tests. This should be maintained as constant as possible throughout the testing period. Measurement of the amount of additional water pumped in during the test will provide a measurement of the amount of leakage, if any. In setting up a section of line for testing, air relief valves should be provided. Air trapped in the line during the test will affect test results and can cause damage to the pipeline and/or injury to workers.

Generally, the engineer will establish the duration of the test, the allowable leakage, and indicate the appropriate methods and procedures for testing. Solvent weld joints should not permit any leakage. However, depending on the type of accessories that are used, a small amount of leakage may be acceptable. Cellular (Foam) Core DWV Pipe may be required to undergo leakage testing. Care must be exercised during assembly to seal all cut ends of the pipe. Water and/or air may permeate into the cellular core under pressure and give the appearance that the pipe is leaking (when it is actually sound). Potable water lines may require disinfecting per AWWA standards.

5.5 MAKING REPAIRS TO DAMAGED PIPELINES

When pipe has been damaged and repair is required, all damaged material may be replaced in kind or the pipe may be repaired using a repair clamp or other methods authorized by the engineer.

If a repair clamp is to be used, the full circle type with opposed bolt line flanges is recommended and should be installed in accordance with the manufacturer's instructions.

Gouges, which have a depth greater than 10 percent of the wall thickness

of the pipe, should be repaired. If the damaged area is localized, a repair clamp may be used. When the damaged area extends beyond a localized area, it is recommended that the damaged section of the pipe be cut out and replaced. In such cases, repair clamps or Dresser type couplings will be required to join the pipe ends. Other types of couplings may be available. Please consult JM Eagle™ for acceptability of these other products.

NOTICE: Trenches and/or casing should be constructed and used in accordance with all applicable state and federal standards to ensure safety.

NOTICE TO ALL READERS OF THIS GUIDE: PVC pipe installation may be hazardous to pipe, property, and/or persons if this guide and/or these recommendations of JM Eagle™ Manufacturing are not adhered to fully. JM Eagle™ has made every effort to expose all known dangers of misusing PVC pipe in this guide; however, JM Eagle™ cannot possibly know or anticipate all situations or outcomes. JM Eagle™ maintains the position that PVC pipe is the most reliable and safest piping material available. Thus, JM Eagle™ encourages all users of its products to exercise good judgment when installing its products and to consult JM Eagle™ for additional information when questions or concepts illustrated herein are not fully answered or understood. It is recommended that all users of its products (or people handling) attend training on pipe construction, installation and safety prior to working with our products to ensure safety, knowledge and understanding. Should you need further assistance, please contact JM Eagle™ Product Assurance at (800) 621-4404.

ELECTRICAL CONDUIT

1.0 SOLVENT-CEMENTING JOINTS FOR PVC RIGID NONMETALLIC CONDUIT, DUCT AND FITTINGS

Most forms of PVC conduit, duct and fittings are meant to be assembled or joined by means of solvent-cementing of the integral bells or PVC couplings. Solvent cements contain chemicals that dissolve the surface of the PVC, softening it. As the chemicals evaporate, they leave a PVC resin behind that fuses the mating surfaces.

1.1 TO PRIME OR NOT TO PRIME?

The National Electrical Code (NEC®) does not require primer to be used in the joining of PVC conduit. However, under some conditions, primer can aid in the ease of assembly and enhance the quality of the joints. Primers are a form of chemical cleaner that may be used to remove surface impurities, soften and dissolve the joining surfaces in order to better prepare them for solvent-cementing.

1.2 SELECTION OF SOLVENT CEMENT

Solvent cements intended for use with PVC conduit and duct should meet all the applicable requirements of ASTM D2564, "Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems." Since they are available in a wide range of viscosities and wet film thicknesses, the nature of the particular project must be considered when trying to decide between a regular, medium or heavy-bodied cement.

1.3 STORAGE OF SOLVENT CEMENT

PVC solvent cements have a limited shelf life and should be stored at a temperature between 40 degrees and 70 degrees F. Consult the solvent cement manufacturer for specific shelf life information and storage recommendations.

Solvent cement is unsuitable for use if it exhibits any sign of gelation. Do not try to restore the viscosity by adding solvents or thinners. Properly dispose of the solvent cement and obtain a fresh supply.

1.4 CUTTING CONDUIT OR DUCT

Cut conduit or duct square with its longitudinal axis using a saw or other suitable tool. Care must be taken to assure that all burrs or ridges are removed from the conduit or duct end as a result of cutting. A knife, file or abrasive paper can be used to remove burrs and apply a slight chamfer to the cut end. (See [Figure 16.](#)) Failure to remove ridges or burrs could result in the cement's being scraped from the socket surface and cause the joint to fail. Ridges or burrs could also damage the conductors or cables being installed.

Cutting Conduit or Duct

Acceptable method

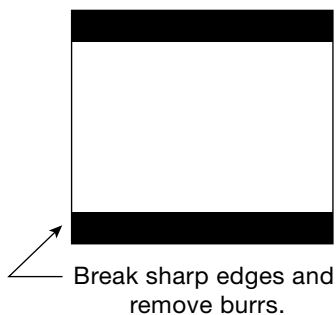


Figure 16

1.5 CLEANING

Surfaces to be joined must be free from dirt, moisture, oil and other foreign material. Wipe surfaces with a clean, dry cloth. If the surfaces require further cleaning, a chemical or mechanical cleaner must be used. Mechanical cleaners include fine abrasive paper or cloth (180 grit or finer) or clean, oil-free steel wool. Chemical cleaners include those recommended by the conduit, duct, fittings or cement manufacturer or a primer meant for use with PVC.

1.6 APPLICATION PROCEDURE

1. Test dry fit of the joint to assure that the conduit or duct and fitting can be joined.
2. If using primer, apply it to the inside socket surface. Use a scrubbing motion to ensure penetration. Then apply primer to the male end to the depth of the fitting socket. Finally, apply primer again to the inside socket surface.
3. Without delay, apply cement lightly but uniformly to the inside socket surface. Take care to keep excess cement out of the socket or bell-topipe transition area. Apply cement to the outer surface of the male end.
4. Immediately after applying the cement to the conduit or duct, while both the joining surfaces are soft and wet with solvent cement, forcefully bottom the male end of the pipe in the socket turning with one-quarter turn. This distributes the cement evenly.
5. After assembly, wipe excess cement from the conduit or duct at the end of the fitting socket. A properly made joint will normally show a bead around its entire circumference.

1.7 ASSEMBLY PRECAUTIONS

PVC solvent cement is fast drying and must be applied as quickly as possible. Assembly should be made within 20 seconds after the last application of cement. If there is any sign of drying of the cemented surfaces, they should be recoated. Hold the assembly in place for approximately one minute to prevent the conduit or duct from backing out of the fitting socket. Care should be taken not to disturb or apply any force to newly assembled joints. The integrity of joints can be compromised by early handling. Recommended set time is related to temperature as follows:

- 30 minutes minimum at 60 degrees to 100 degree F
- 1 hour minimum at 40 degree to 60 degree F
- 2 hours minimum at 20 degree to 40 degree F
- 4 hours minimum at 0 degree to 20 degree F

1.8 ATMOSPHERIC CONSIDERATIONS

Under conditions of high humidity, quick application of solvent cement is important to minimize condensation of moisture from the air on the cement surface. Temperatures of the mating surfaces should not exceed 110 degrees F at the time of assembly. The temperature may be reduced by swabbing the surface to be cemented with a wet rag provided the conduit or duct is thoroughly dry before cement is applied.

At temperatures below freezing, solvent cements penetrate and soften PVC slower than in warmer weather. As solvent cements and primers are highly flammable, do not use open flame or electric heaters to warm them. Care should be taken to remove moisture such as ice and snow from pipe and fitting surfaces before applying cements and primers. In cold weather, use primers to soften joining surfaces before applying cement.

Source: ASTM D2855, "Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings."

This section (6.0-6.8) was prepared by the NEMA Polymer Raceway Products (5TC) PVC Technical Committee.

APPENDIX 1

EMBEDMENT MATERIALS

Materials suitable for foundation and embedment are classified in the following [Table A1.1](#). They include a number of processed materials plus soil types defined according to the Unified Soil Classification System (USCS) in ASTM D 2487, "Standard Method for Classification of Soils for Engineering Purposes." [Table A1.2](#) provides recommendations on the installation and use based on class of soil or aggregates and location within the trench. It is important to engineer all materials used in the pipe trench to work together and with the native material surrounding the trench.

Class IA Materials: Class IA materials provide the maximum stability and pipe support for a given density because of the angular interlocking of the material particles. With minimum efforts, these materials can be installed at relatively high densities over a wide range of moisture contents. These materials also have excellent drainage characteristics that may aid in the control of water. These soils are often desirable as embedment in rock cuts where water is frequently encountered. On the other hand, when ground water flow is anticipated, consideration should be given to potential migration of fines from adjacent materials into the open graded Class IA materials.

Class IB Materials: Class IB materials are produced by mixing Class IA and natural or processed sands to produce a particle-size distribution that minimizes migration from surrounding soils that may contain fines. They are more widely graded than Class IA and thus require more compaction effort to achieve the minimum density specified. When these materials are properly compacted, these soils exhibit high stiffness and strength, and depending on the amount of fines, may be relatively free draining.

Class II Materials: When Class II materials are compacted, they provide a relatively high level of pipe support. In most respects, they all have the desirable characteristics of Class IB materials when widely graded. However, open-graded groups may allow for migration and the sizes should be checked for compatibility with the native trench materials. Typically, Class II materials consist of rounded particles and are less stable than the angular materials of Class IA and IB unless they are confined and compacted.

Class III Materials: These materials provide less support for a given density than Class I or Class II materials. High levels of compaction effort are required if moisture content is not controlled. These materials will provide reasonable support once proper compaction is achieved.

Class IV-A Materials: Class IV-A materials must be carefully evaluated before use. The moisture content of the materials must be near optimum to minimize compaction effort and achieve the required density. Properly placed and compacted, these soils can provide reasonable levels of pipe support. However, these materials may not be suitable under high fills, surface applied dynamic loads, or under heavy vibratory compactors and tampers. These materials should be avoided if water conditions in the trench may cause instability and result in uncontrolled water content.

Table A1.1

Description of Material Classification as Defined in ASTM D2321

Class	Type	Soil Symbol Group	Description ASTM D2487	Percentage Passing Sieve Sizes			Atterberg Limits		Coefficients	
				1.5 in (40 mm)	No.4 (4.75 mm)	No.200 (.075 mm)	LL	PL	Uniformity Cu	Curvature Cc
IA	Manufactured Aggregates: open graded, clean	None	Angular, crushed stone or rock, crushed slag, cinders or shell: large void content, contain little or no fines	100%	< or = 10%	< 5%	Non Plastic			
IB	Manufactured, Processed Aggregates: dense graded, clean	None	Angular, crushed stone (or other Class IA materials) and stone/sand mixtures with gradations selected to minimize migration of adjacent soils: contain little to no fines	100%	< or = 50%	< 5%	Non Plastic			
II	Coarse-Grained Soils: clean	GW	Well-graded gravels and gravel-sand mixtures: little to no fines	100%	< 50% of coarse fraction	< 5%	Non Plastic		> 4	1 to 3
		GP	Poorly-graded gravels and gravel-sand mixtures: little to no fines						< 4	< 1 or > 3
		SW	Well-graded sands and gravelly sands: little to no fines		< 50% of coarse fraction				> 6	1 to 3
		SP	Poorly-graded sands and gravelly sands: little to no fines						< 6	< 1 or > 3
	Coarse-Grained Soils: borderline clean to w/fines		Sands and gravels which are borderline between clean and with fines	100%	varies	5% to 12%	Non Plastic			Same as for GW, GP, SW, and SP

Based on tables found in the Uni-Bell® PVC Pipe Association, "Handbook of PVC Pipe Design and Construction."

Table A1.1 continued

Class	Type	Soil Symbol Group	Description ASTM D2487	Percentage Passing Sieve Sizes			Atterberg Limits		Coefficients	
				1.5 in (40 mm)	No.4 (4.75 mm)	No.200 (.075 mm)	LL	PL	Uniformity Cu	Curvature Cc
III	Coarse-Grained Soils w/ Fines	GM	Silty gravels, gravel-sand-silt mixtures	100%	> 50% of coarse fraction	> 12% to < 50%		< 4 or < "A" Line		
		GC	Clayey gravels, gravel-sand-clay mixtures					< 7 and > "A" Line		
		SM	Silty sands, sand-silt mixtures		> 50% of coarse fraction			> 4 or < "A" Line		
		SC	Clayey sands, sand-silt mixtures					> 7 and > "A" Line		
IV-A	Fine-Grained Soils: Inorganic	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, silts with slight plasticity	100%	100%	> 50%		< 4 or < "A" Line		
		CL	Inorganic clays of low to medium plasticity, gravely clays, sandy clays, silty clays, lean clays					> 7 and > "A" Line		

Based on tables found in the Uni-Bell® PVC Pipe Association, "Handbook of PVC Pipe Design and Construction."

Table A1.2

Recommendations for Installation and Use of Soils and Aggregates for Foundation, Embedment, and Backfill

Soil Class as Defined in Table A1.1					
	Class IA	Class IB	Class II	Class III	Class IV-A
General Recommendations and Restrictions	Do not use where conditions may cause migration of fines from adjacent soil and loss of pipe support. Suitable for use as a drainage blanket and underdrain in rock cuts where adjacent material is suitably graded.	Process materials as required to obtain gradation which will minimize migration of adjacent materials. Suitable for use as drainage blanket and underdrain.	Where hydraulic gradient exists check gradation to minimize migration. "Clean" groups suitable for use as drainage blanket and underdrain.	Do not use where water conditions in trench may cause instability	Obtain geotechnical evaluation of processed material. May not be suitable under high earth fills, surface applied loads and under heavy vibratory compactors and tampers. Do not use where water conditions in trench may cause instability.
Foundation	Suitable as foundation and for replacing over-excavated and unstable trench bottom as restricted above. Install and compact in 6-inch maximum layers.	Suitable as foundation and for replacing over-excavated and unstable trench bottom. Install and compact in 6-inch maximum layers.	Suitable as foundation and for replacing over-excavated and unstable trench bottom as restricted above. Do not use in thicknesses greater than 12 inches total. Install and compact in 6-inch maximum layers.	Suitable as foundation and for replacing over-excavated trench bottom as restricted above. Do not use in thicknesses greater than 12 inches total. Install and compact in 6-inch maximum layers.	Suitable only in undisturbed condition and where trench is dry. Remove all loose material and provide firm, uniform trench bottom before bedding is placed.

Based on tables found in the Uni-Bell® PVC Pipe Association, "Handbook of PVC Pipe Design and Construction."

Table A1.2 continued

Soil Class as Defined in Table A1.1					
	Class IA	Class IB	Class II	Class III	Class IV-A
Bedding	Suitable as restricted above. Install in 6-inch maximum layers. Level final grade by hand. Minimum depth 4 inches (6 inches in rock cuts).	Install and compact in 6-inch maximum layers. Level final grade by hand. Minimum depth 4 inches (6 inches in rock cuts).	Suitable as restricted above. Install and compact in 6-inch maximum layers. Level final grade by hand. Minimum depth 4 inches (6 inches in rock cuts).	Suitable only in dry trench conditions. Install and compact in 6-inch maximum layers. Level final grade by hand. Minimum depth 4 inches (6 inches in rock cuts).	Suitable only in dry-trench conditions and when optimum placement and compaction control is maintained. Install and compact in 6-inch maximum layers. Level final grade by hand. Minimum depth 4 inches (6 inches in rock cuts).
Haunching	Suitable as restricted above. Install in 6-inch maximum layers. Work in around pipe by hand to provide uniform support.	Install and compact in 6-inch maximum layers. Work in around pipe by hand to provide uniform support.	Suitable as restricted above. Install and compact in 6-inch maximum layers. Work in around pipe by hand to provide uniform support.	Suitable as restricted above. Install and compact in 6-inch maximum layers. Work in around pipe by hand to provide uniform support.	Suitable only in dry trench conditions and when optimum placement and compaction control is maintained. Install and compact in 6-inch maximum layers. Work in around pipe by hand to provide uniform support.
Initial Backfill	Suitable as restricted above. Install to a minimum of 6 inches above pipe crown.	Install and compact to a minimum of 6 inches above pipe crown.	Suitable as restricted above. Install and compact to a minimum of 6 inches above pipe crown.	Suitable as restricted above. Install and compact to a minimum of 6 inches above pipe crown.	Suitable as restricted above. Install and compact to a minimum of 6 inches above pipe crown.
Final Backfill	Compact as required by the engineer.	Compact as required by the engineer.	Compact as required by the engineer.	Compact as required by the engineer.	Suitable as restricted above. Compact as required by the engineer.

Based on tables found in the Uni-Bell® PVC Pipe Association, "Handbook of PVC Pipe Design and Construction."



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