PERMA-PIPE®

CHIL-GARD
Preinsulated Piping Systems

Installation Manual

ISSUE 1

JUNE 15, 1998

PERMA-PIPE, INC.

A Subsidiary of MFRI, Inc.

7720 North Lehigh Avenue

Niles, Illinois 60714-3491

Phone (847) 966-2235

FAX (847) 470-1204

http://www.permapipe.com

Chil-Gard Table of Contents

NOTICE

This installation manual and the recommendations it contains are reasonably believed to be accurate and reliable. However, due to variations in environment, application or installation, and because the conditions of use are beyond our control, the user of this manual assumes all risk connected with the use thereof. The installer of these piping products is ultimately responsible for his own work and, thus, the integrity of the system. PERMA-PIPE assumes no responsibility for the use of information presented herein and, hereby, expressly disclaims all liability in regard to such use.

Any technical suggestions or advice with respect to storage, handling, installation or use of Seller's materials by or on behalf of Seller is an accommodation to Purchaser for which Seller shall have no responsibility unless responsibility, therefore, has been expressly assumed in writing by the President or a Vice-President of Seller.

PREFACE

The consulting engineer has been provided with information on what to expect from a PERMA-PIPE Chil-Gard system once it is installed. However, the true operating success of the system is greatly dependent upon proper installation. PERMA-PIPE is committed to supporting the installation of a complete and high-quality piping system. This support includes clear and concise installation recommendations and expert field technical assistance.

The objective of this manual is to aid the installer on recommended installation procedures of a Chil-Gard piping system. This booklet contains information on all aspects of the installation process, from initial receiving and storage through final backfill.

The manual has been divided into sections, one section for each phase of the installation process. Each section contains an explanation and illustrations on proper installation procedures.

By following these step by step instructions, the installing contractor should achieve a successful installation.

GENERAL PRECAUTIONS

These instructions are for general applicability. If they conflict with contract, specifications or drawings specific to the job, the job-specific documents take precedence. If in doubt, check with your project engineer or PERMA-PIPE field technical representative.

Carefully observe job work sequence to avoid errors and expensive mistakes. **DO NOT skip steps.**

DO NOT complete backfilling the trench until all testing and inspection is completed and accepted by the appropriate authority.

1.0 INTRODUCTION

Chil-Gard is a completely preinsulated, prefabricated system designed for the distribution of chilled water.

Chil-Gard consists of a polyvinyl chloride (PVC) plastic carrier pipe designed for use at maximum hydrostatic working pressure of 160 psi at 73°F (class 160) and 200 psi at 73°F (class 200). The pipe is insulated with polyurethane foam and encased and sealed in a rugged PVC jacket. The features that make Chil-Gard unique extend beyond the product itself. An expert project design staff tailors each system to meet the needs of the customer. Also, an experienced technical service staff is available to provide assistance that will assure a quick and smooth installation.

A series of factors contribute to a reliable, high quality piping system, such as design, construction, delivery, installation and testing, with stringent quality control procedures applied at every step. The importance of proper installation practices for any piping system and adherance to this procedure, in particular, cannot be overstated. When installed according to the recommended practices presented in this manual and from PERMA-PIPE technical service, Chil-Gard will provide excellent service, meeting or exceeding expectations.

2.0 SCOPE AND APPLICATION

The scope of this procedure is limited to Chil-Gard piping systems.

This procedure applies to the customer-designated contractor who will perform the installation. A factory-trained, experienced field installation instructor will be present at critical periods during the installation, when required by the specifications, and/or where the furnishing of such service is included as a part of the customer's purchase order.

Trouble-free, efficient operation will result from close cooperation between the installing contractor and the field installation instructor. PERMA-PIPE is committed to

supporting the proper installation of a complete and high quality piping system. Nevertheless, ultimate responsibility for proper installation rests with the installing contractor.

3.0 EQUIPMENT AND MATERIAL

3.01 Equipment and Material.

In order to install Chil-Gard, PERMA-PIPE has furnished the following:

1. Pipe assemblies, fittings and accessories
2. Field joint closure materials (see applicable chapters of Section **7.0**)

Installing contractor must furnish the following:

1. Crane and excavation equipment
2. Ruler and straight edge
3. Circular saw and blades
4. Hammer, chisel, linoleum knife and beveling tool
5. Spud bar and wood block
6. Paint brushes and clean rags
7. Other materials as described in applicable chapters of Section **7.0**.

3.02 Receiving, Handling and Storage.

3.02.1 Receiving.

The piping was inspected and loaded with due care at the factory. It is the carrier's responsibility to deliver the shipment in good condition. It is the responsibility of the receiver to ensure there has been no loss or damage. The following procedures are suggested to minimize problems:

- It is recommended that the PERMA-PIPE field representative be present during receipt of the shipment.
- Obtain following items from the carrier:

1. Part Drawing Layout (PDL), if applicable
2. Packing slip
3. Bill of Lading
4. MSDS Sheets

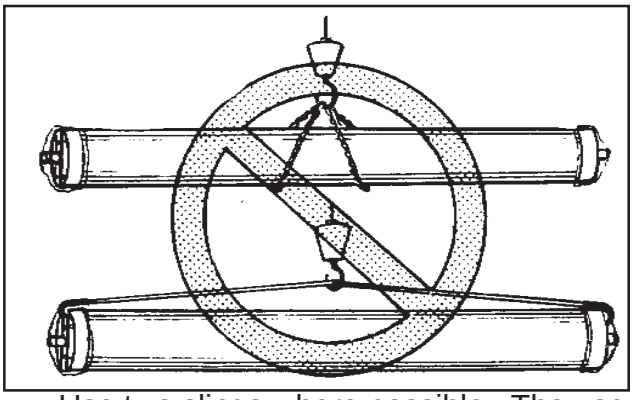
NOTE: Material Safety Data Sheets (MSDS) for each of the components described in this manual should be reviewed for safety precautions and protective equipment requirements.

- Check all shipped materials against the packing slip for shortages.
- Visually inspect the materials of shipment as they are unloaded.
- List all damages and/or shortages on the packing slip and the bill of lading. **DO NOT dispose of any damaged material.** The carrier will notify you of the necessary procedure to be followed.
- Submit claims to the carrier. Failure to do so will result in loss of compensation for missing or damaged material.
- Notify your PERMA-PIPE field representative of these claims if assistance is required. PERMA-PIPE terms are F.O.B. our plant, full freight allowed to project site, unless specified differently by contract or purchase order.
- Shortages and damaged materials are normally not reshipped, unless requested to do so. If replacement material is needed, contact a PERMA-PIPE sales representative.

3.02.2 Material Handling.

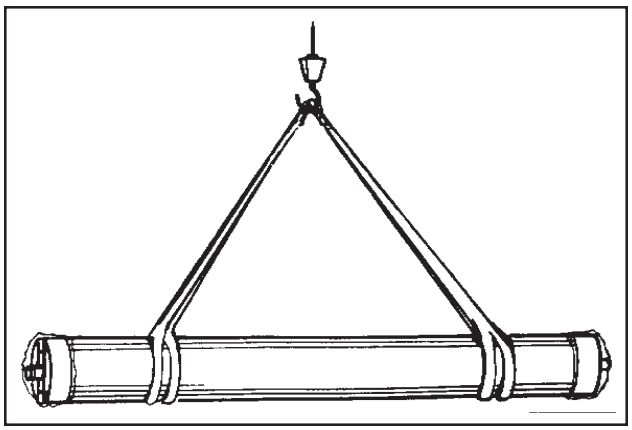
The means by which Chil-Gard is unloaded and handled in the field is the decision and responsibility of the receiver. PERMA-PIPE's PVC jacket is designed to resist corrosion and is strong enough to withstand heavy soil loads and system pressures. The jacket is extremely durable. However, if damage does occur due to improper handling, the jacket must be repaired at the customer's expense. The following procedures are suggested to minimize problems:

- Support each assembly with pipe size of 8 inches or larger with nylon slings during all phases of handling. The nylon slings prevent severe scratching and/or chipping of the PVC jacket. Nylon slings are provided free of charge by PERMA-PIPE.
- **DO NOT use steel cables or chains for handling Chil-Gard assemblies.**



• Use two slings where possible. The use of two slings provides much more control of pipe movement. This greatly decreases the chances of personal injury and/or damage to the pipe from contact with the truck, nearby buildings and equipment.

• Choke the slings together as shown. Space the slings about 10 feet apart.



• **DO NOT drop the Chil-Gard assemblies or strike them against hard surfaces at any time.**

• If an accident occurs, inspect the jacket and pipe ends for damages. Repair if necessary (see Section **8.02**).

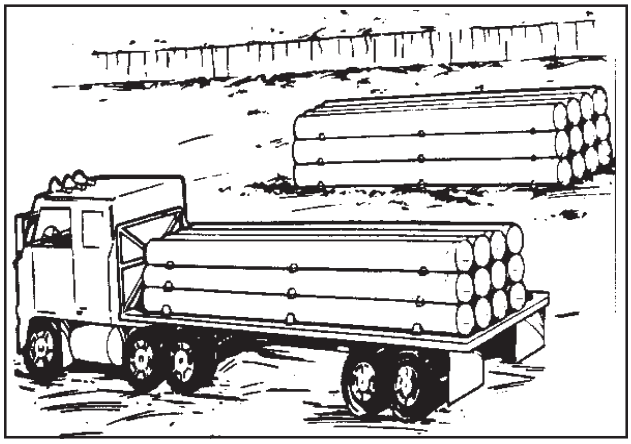
3.02.3 Pipe Storage.

Chil-Gard assemblies can sustain damage if not stored properly. Proper storage of the product is the responsibility of the receiver. The following procedures are suggested to minimize problems:

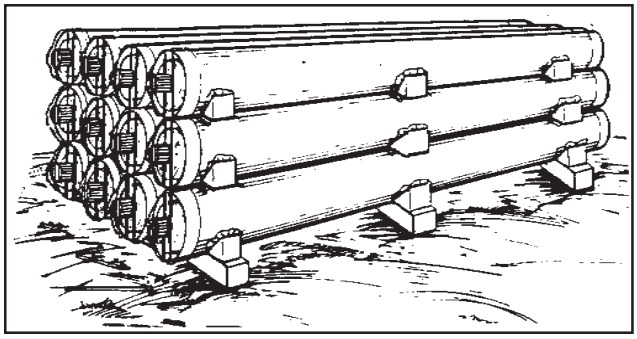
• If possible, store the pipe in a warehouse or heated shelter. If this is not possible, store the pipe on high ground to avoid ingress of water into pipe ends.

• Chil-Gard can be stored during the winter months (or for prolonged periods of time) with minimal special handling.

• When stacking the CHIL-GARD for storage, stack it in the same fashion that it was received.



• Wooden shipping braces must be used as runners between the layers of pipe. PERMA-PIPE recommends stacking pipe no more than six feet high.



• **DO NOT remove plastic covers or end caps from the Chil-Gard.** Dirt and debris must be prevented from entering the pipe.

• PERMA-PIPE recommends using a light-colored or opaque tarpaulin to cover stored pipe. This cover will protect it against ultraviolet (UV) rays that will discolor the PVC jacket.

• Store all field joint materials indoors and in a dry area. Keep the materials in their shipping containers. The recommended storage temperature range is 60°-85°F (18°-29°C).

4.0 PREPARATION AND SET UP

PERMA-PIPE cannot anticipate every circumstance that might involve hazard. The warnings in this procedure are, therefore, not all inclusive. The installing contractor must satisfy himself that each procedure, tool, work method or operating technique is safe.

PERMA-PIPE recommends that only qualified personnel perform all steps of the installation procedure.

Proper implements, tools and equipment should be used for placement of the pipe in the trench to prevent damage. In no case should pipe or accessories be dropped into the trench. Additional handling and joining procedures are covered elsewhere in this manual. Pipe laying generally should commence at the lowest elevation and terminate at manholes, service branches or clean outs.

5.0 EXCAVATION

NOTE: All federal, state and local regulations concerning jobsite safety should be observed.

5.01 Trenching.

All types of flexible pipe derive some of their strength from the passive soil resistance on the sides of the pipe. Therefore, the proper excavation of the trench is very important to ensure a structurally sound system. Usually, the centerline dimensions for the placement of the pipe in the trench can be found in the drawings.

Chil-Gard is designed to handle normal soil and H-20 loading. If PERMA-PIPE's recommended procedures are followed, a minimum burial depth is required at taxiways, runways, railroads and other areas of high surface loading conditions. It is recommended that the customer contact both PERMA-PIPE and the local authority for more specific burial instructions.

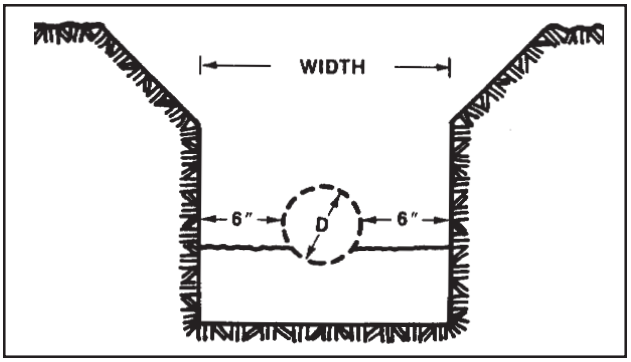
The trench floor should be completely cleared of stones and rocks and covered with a 4-inch compacted bedding. The bedding soil should correspond with the soil description.

During excavation, an unstable soil condition may be encountered, particularly in installations with deep burials. If this occurs, shore the trench walls before lowering the piping assembly into the trench.

As the shoring is removed, it should be replaced with backfill soil.

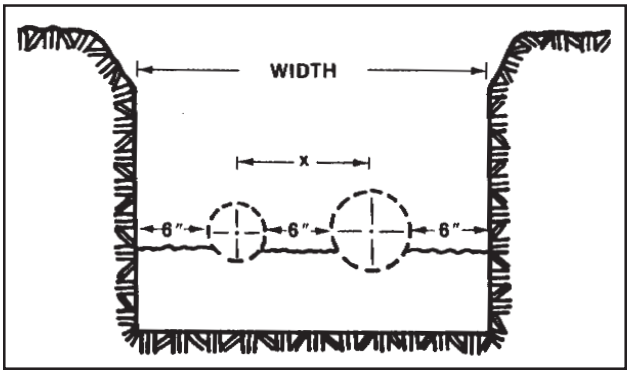
Organic soils or plastic clays and silts with high liquid limits may be encountered that are incapable of supporting the pipe. Remove the poor soil, and replace it with the proper bedding soil to a depth that will provide a firm stable foundation.

The minimum recommended trench width for single pipe is 12 inches plus the diameter of the conduit.



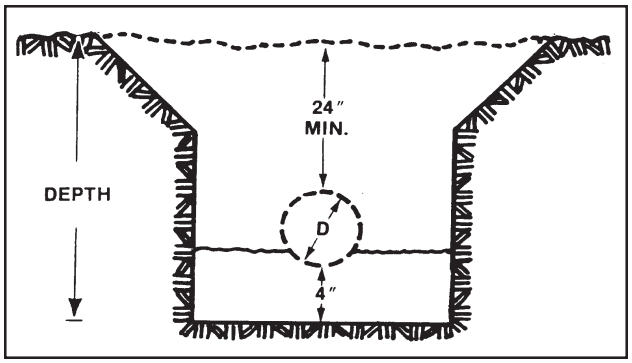
For multi-pipe installations, centerline dimensions can usually be found in the drawings.

If the centerline dimensions are not specified in the drawings, PERMA-PIPE recommends computing the width of a multi-pipe trench by adding 6 inches to the combined radii of each pair of pipes (value X in the figure below) and, then, adding another 12



inches and the combined radii of the two outermost pipes to allow for clearance.

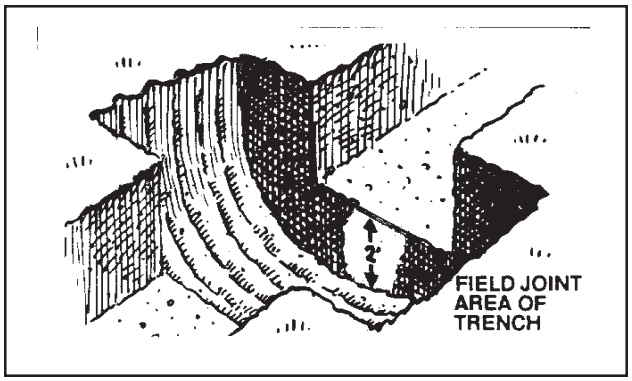
The total trench depth should allow for a 4-inch bedding, the conduit diameter and a minimum 24 inches cover depth above the conduit. See contract drawings for specific pipe burial depths. For depths less than 24 inches, contact PERMA-PIPE.



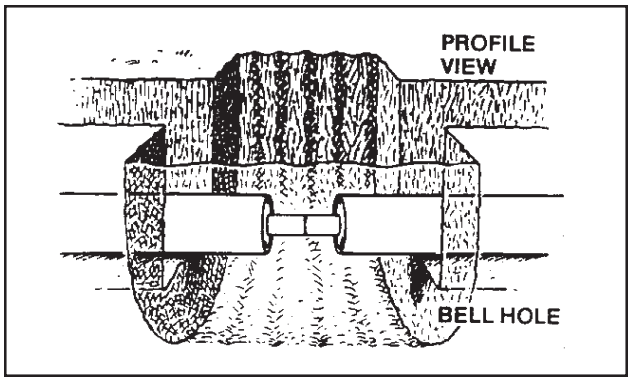
A minimum bedding of 4 inches must be raked uniformly along the entire length of the run. The bed of the run must be graded to a minimum slope of 1 inch per 40 feet. The bedding material should conform with the recommendations in the **Backfill** section of this manual (see Section **9.0**).

5.02 Bell Holes.

Digging bell holes at field joint locations allows room for pipe joining, field joint closure and testing. A common way to dig bell holes is to cut across the trench with a backhoe:



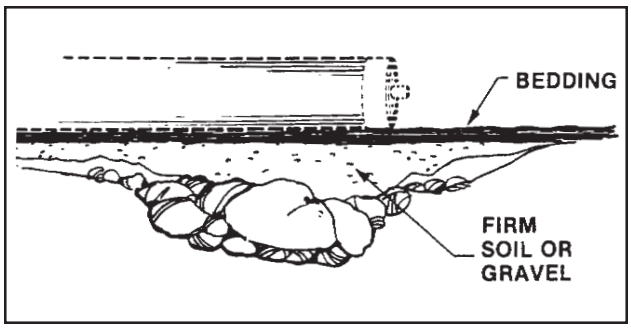
- Cut into the side of the trench and 1½ to 2 feet below the system grade.
- Dig the bell holes before lowering Chil-Gard into the trench.



5.03 Special Trench Conditions.

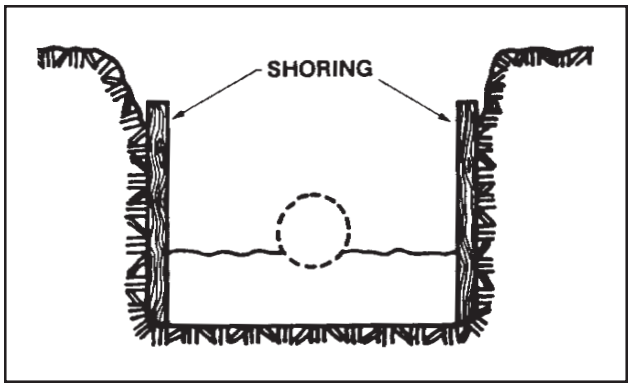
5.03.1 Rock Bottom Trench.

- A rocky or uneven trench foundation should be covered with a firm soil or gravel before bedding is constructed.



5.03.2 Unstable Soil.

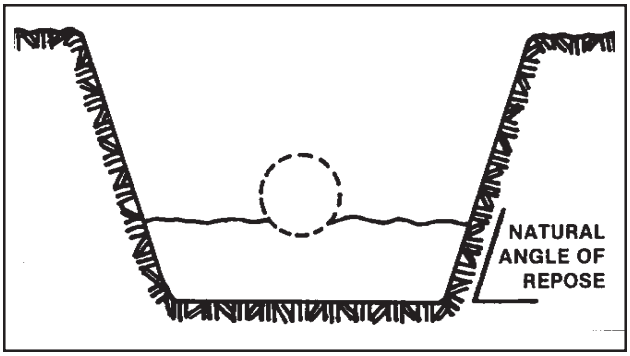
- When trenching in unstable soil, **DO NOT lay any Chil-Gard until the trench walls are stabilized with staybracing or shoring.**



- Replace and compact the soil as the shoring is removed.

5.03.3 Granular Soil.

• In granular soil, the trench wall should be sloped at the natural angle of repose.



5.03.4 Over-excavation.

• Any accidental over-excavation should be filled with bedding material and compacted to 90-95% modified proctor.

6.0 CHIL-GARD ASSEMBLY

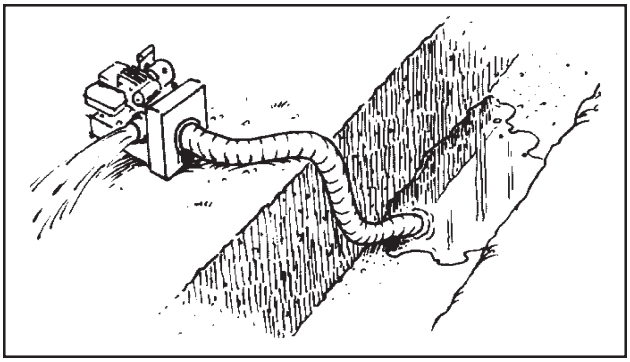
NOTE: When installing pipe in ambient temperatures below 60°F, contact your PERMA-PIPE field representative for special cold weather procedures.

6.01 Chil-Gard Layout.

After trench excavation is complete and installation of the pipe is to start, the Chil-Gard assemblies should be distributed along the trench top.

6.02 Lowering of the Piping.

• Remove free-standing water in the bell hole and trench before lowering assemblies. Bell holes and bedding must be dry during pipe assembly installation.



• **DO NOT remove the protective end covers until the carrier pipes are to be joined.**

• Lower Chil-Gard assemblies into the trench. **DO NOT drop piping.**

6.03 Pipe Connections.

If sufficient lowering equipment is available, it may be easier to complete some field joints outside the trench.

NOTE: Joining sections of pipe outside of the trench may result in the need for a crane to lower the joined piping into the trench. If joining two 20' sections in this manner, **DO NOT allow the piping to bow.**

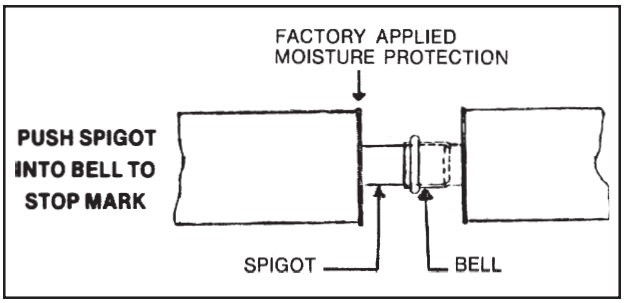
6.03.1 Push Joint Procedure.

The standard Chil-Gard joint is a spigot and bell configuration wherein the bell gasket forms a water-tight seal against the inserted spigot.

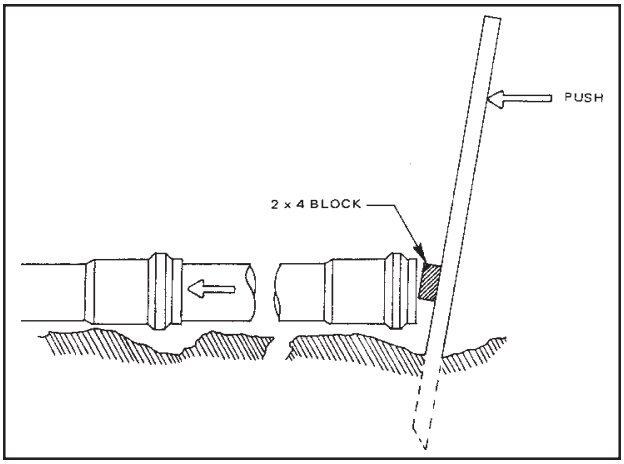
• Wipe the inside of the bell and spigot ends which are to be joined.

• Lubricate the bell gasket and spigot end with a non-petroleum base, commercial grade PVC lubricant.

• Push the lubricated spigot end into the bell socket up to the stop mark. **DO NOT seat the spigot against the bottom of the socket.**



NOTE: DO NOT swing or stab the joint. Apply a firm, steady pressure by hand or by using a spud bar and block.



6.03.2 Solvent Weld Joining Procedure.

An alternative method of joining Chil-Gard assemblies is the solvent weld procedure. Joints of plastic pipe and fittings can be readily and rapidly made leak-free using the solvent weld procedure, but it requires planned and orderly activity. The temperature of pipe, fittings and cement should be in the range of 40°F to 100°F during assembly and cure. If pipe temperature exceeds 100°F, the pipe and fittings must be cooled. All fitting sockets, pipe ends (spigots), and pipe sockets must be clean and dry. Water is incompatible with PVC solvent cements.

NOTE: DO NOT attempt to thin PVC cement by adding solvents or thinners. Use cement as is. Cements should be used

within one year of the date stamped on the container.

In making consistently good joints, the following basic principles apply:

• The joining surfaces must be softened and made semifluid.

• Sufficient cement must be applied to fill the gap between pipe and fitting.

• Assembly of pipe and fittings must be made while the surfaces are still wet and fluid.

• Joint strength develops as the cement dries. In the tight part of the joint, the surfaces will tend to fuse together. In the loose part, the cement will bond to both surfaces.

6.03.2.1 Preparation of Pipe Ends.

• Cut pipe square. A diagonal cut reduces bonding areas in the most effective part of the joint.

• Remove all burrs with file or knife. Burrs will scrape away cement, leaving voids.

• Remove dirt, grease and moisture. Wipe thoroughly with a clean, dry rag. Moisture will retard cure, and dirt and grease can prevent adhesion.

• Check pipe and fittings for fit (dry) before cementing. For proper interference fit, the pipe must go easily into the fittings ¼ to ¾ of the way. Too tight a fit is not desirable. You must be able to fully bottom the pipe in the socket during assembly. If the pipe and fittings are not out of round, a satisfactory joint can be made if there is a "net" fit--that is, the pipe bottoms in the fitting socket with no interference, but without slop.

• Use PVC primer to penetrate and soften the surfaces so they can fuse together. Apply primer freely to fitting socket, keeping the surface and applicator wet until the surface has been softened. This usually requires 5-15 seconds. More time is needed for hard surfaces and cold weather conditions. Redip the applicator in primer as required. When the surface is primed, remove any puddles of primer from the socket.

• Apply primer to the end of the pipe equal to the depth of the fitting socket. Application should be made in the same manner as was done on the fitting socket.

• Apply the primer a second time if it has unusually hard surfaces. These hard surfaces are often found in Bell-ends and in fittings made from pipe stock. They also can occur in some molded fittings.

6.03.2.2 Application of Adhesive.

• Immediately, and while surfaces are still wet, apply appropriate PVC cement.

• Apply cement first to the pipe, then to the fitting, then a second coat to the pipe using a brush that is ½ the pipe size.

• Coat the mating surfaces of pipe and fitting rapidly and thoroughly leaving no voids.

SOLVENT WELD CURE TIME TABLE

TEST PRESSURES FOR PIPE SIZES	½" TO 1-¼"		1-½" TO 3"		3-½" TO 12"	
Relative Humidity 60% or less*	Up to 180 PSI	Above 180 to 370 PSI	Up to 180 PSI	Above 180 to 370 PSI	Up to 180 PSI	Above 180 to 370 PSI
60° - 100° F	1 Hr.	6 Hr.	2 Hr.	12 Hr.	6 Hr.	24 Hr.
40° - 60° F	2 Hr.	12 Hr.	4 Hr.	24 Hr.	12 Hr.	48 Hr.
10° - 40° F	8 Hr.	48 Hr.	16 Hr.	96 Hr.	48 Hr.	8 Days

(*) In damp or humid weather, allow 50% more cure time.

Longer cure periods are necessary for low temperature, large pipe sizes, loose fits and relatively high humidity.

NOTE: Coatings on both pipe and fittings should be more than sufficient to fill the joint when assembled. Coating on pipe should be very liberal, but avoid puddling and excess cement in fitting.

• Assemble parts quickly, within 20 seconds of last applied adhesive. Parts must be assembled while cement is still fluid. If assembly is interrupted, recoat parts and assemble.

6.03.2.3 Joining Procedure.

• Without delay, insert the pipe fully into the fitting using a turning motion of $^1/_8$ to $^1/_4$ of a turn until it bottoms.

NOTE: DO NOT swing or stab the joint. Apply a firm, steady pressure by hand or using a spud bar and block.

• Hold pipe and fitting together for a minute or so to offset tendency of pipe to move out of fitting.

• Remove all the excess cement from the pipe and fitting, including the ring or bead formed at the joint as it will needlessly soften the pipe and fitting and does not add to joint strength.

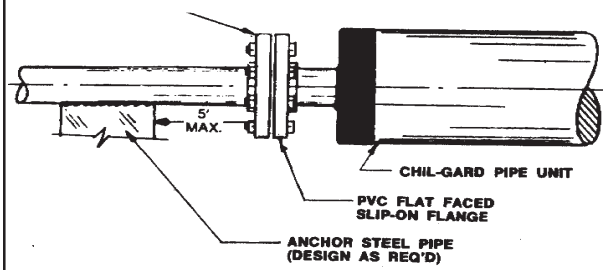
NOTE: DO NOT move, vibrate or otherwise disturb the joint during cure of adhesive.

• Allow joint to cure in accordance with the Cure Time Talble.

6.03.3 Building Piping Connections--Using a PVC Flange.

PVC flanges are flat-faced and are used at all terminal ends to mate with metal flat-faced flanges. Metal pipe must be anchored immediately adjacent to metal flange to keep external forces from PVC pipe.

COMPANION 150# STEEL FLAT FACED FLANGE WITH FULL FACED RUBBER GASKET AND BOLTS



NOTE: It is recommended that at least one rubber gasketed joint be installed between fixed locations to compensate for expansion or contraction.

RECOMMENDED FLANGE BOLT TORQUE FOR PLASTIC FLANGES		
FLANGE SIZE	BOLT DIAMETER	TORQUE FT-LB
½"	½"	10 - 15
¾"	½"	10 - 15
1"	½"	10 - 15
1-¼"	½"	10 - 15
1-½"	½"	10 - 15
2"	5/8"	20 - 30
2-½"	5/8"	20 - 30
3"	5/8"	20 - 30
4"	5/8"	20 - 30
6"	3/4"	33 - 50
8"	3/4"	33 - 50
10"	7/8"	53 - 75
12"	1"	80 - 110

(*) To give the bolt stress of 10,000 - 15,000 psi. Bolt torque assumes a well- lubricated bolt.

Do not torque PVC flange bolts beyond these recommended values.

Soft rubber gaskets should be used between the flanges.

• Use soft rubber gaskets between flanges.

• Use washers at both nut and bolt end of PVC flanges.

• Due to the rigidity of the units, it is important to have a smooth and level trench floor. The units must be supported uniformly to prevent localized bending forces at pipe joints.

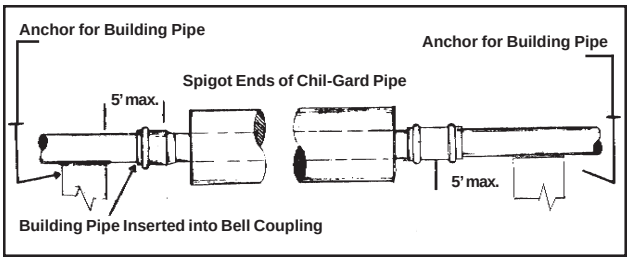
• Use care when installing elbows and tees. Provide sufficient anchor when making connections at direction changes (see Section **6.04**).

• Where flanges are used, ensure that installed lengths have been measured correctly.

NOTE: DO NOT bend or bow assembled units in trenches. Handling of assembled units is discouraged. In-place assembly is recommended.

6.03.4 Building Piping Connections--Push-fit or Mechanical Joint.

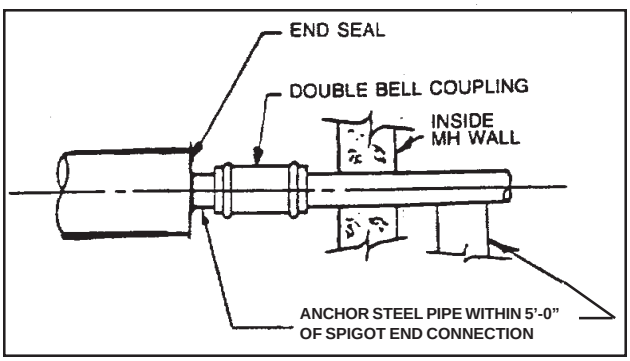
Building piping connections can be made using double bell couplings to join the PVC pipe to the building pipe.



- Join the PVC pipe and fitting as described in Section 6.03.1.
- Using a factory-beveled PVC pipe end as a guide, taper the building pipe end with a torch and/or file.
- Paint or mark the stop point on the building pipe. Use a factory mark as a guide.
- Press the bell coupling onto the building pipe. Bottom the pipe into the bell coupling.

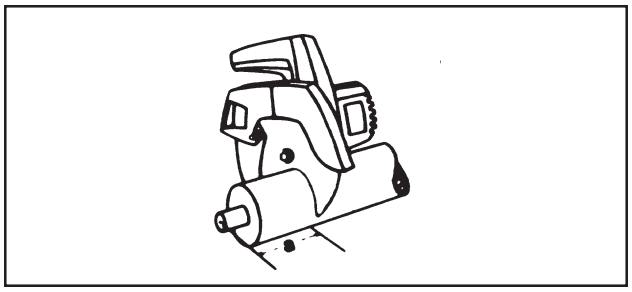
6.03.5 Manhole Piping Connection.

For manholes containing both hot and chilled water lines, it is recommended that the chilled water be piped with steel inside the manhole and extended outside for connection to the PVC. Steel pipe should be coated with a corrosion resistant coating.

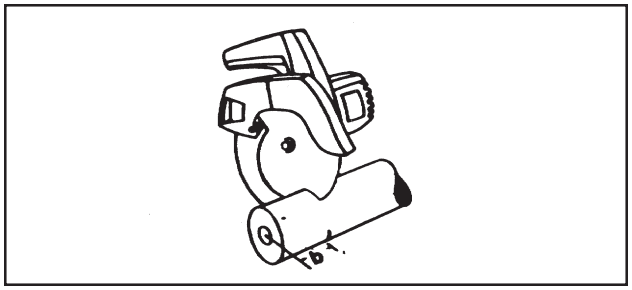


6.03.6 Field Alterations of Pipe Length.

- Determine amount which standard units are to be shortened. Using this figure, measure back from end of pipe to a point on the outer jacket and mark. Cut completely through unit.



- Measure back a dimension equal to a factory-prepared pipe end and cut through jacket only. **DO NOT cut inner pipe.**

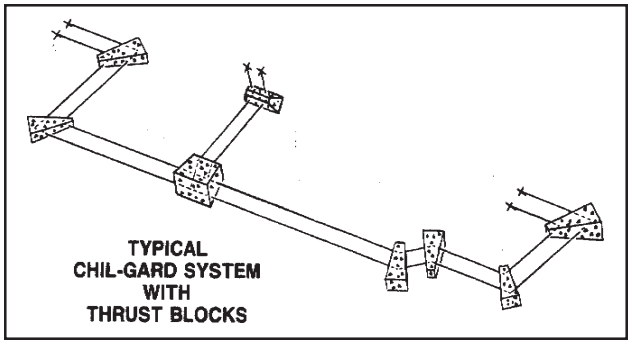


- To remove jacket and urethane foam from pipe end, cut longitudinally into three segments and peel the insulation and jacket off the pipe. Clean the pipe of any residual urethane.
- Before applying insulation sealant, ensure that insulation in jacket surface is clean and dry. Remove dust and foreign matter by brushing.
- Apply two coats of mastic over the insulation. Apply second coat one hour after applying the first coat. **DO NOT thin mastic.**

NOTE: Mastic must cover the insulation surface and approximately 1/2 inch of the pipe surface and outer jacket surface.

6.04 Concrete Thrust Blocks.

Thrust blocks must be included to prevent any of the bell and spigot rubber gasketed

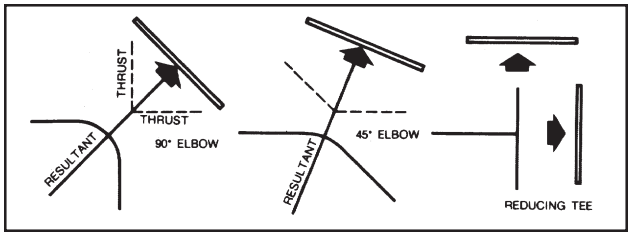


joints from parting under presure. Poured concrete is the preferred method of anchoring the Chil-Gard assemblies.

Since thrust blocks are an integral part of the system, they should be poured prior to hydrostatic testing of the pipe. Temporary blocking may be used with extreme caution if absolutely necessary. Howerer, the system should be retested after the permanent blocks are poured to prove the blocks will resist the thrust.

Thrust blocks must be located at:

1. All changes in direction, such as tees and elbows (both horizontal and vertical).
2. All changes in size such as reducers.
3. All terminal or “dead” ends, such as caps, plugs and closed valves.
4. All valves, in order to support their weight and prevent excessive torque on the pipe connections.



NOTE: Any connecting metallic pipe must be anchored at the point of connection to the PVC pipe to prevent excessive stresses being transferred to the PVC pipe.

The design of the anchor block is dependent upon soil conditions, size and number of pipes, the forces due to thermal stress, and the type of fittings involved. Four conditions must be present if the anchor blocks are to do their job:

1. The bearing area must be adequate to resist the pressure force.
2. The bearing surface must rest directly against undisturbed soil.
3. The face of the block bearing surface in the soil must be perpendicular to the resultant direction of the thrust.
4. Thrust blocks must encase a minimum of 2 inches of the outer jacket with a minimum 6 inch thickness of concrete.

If anchor blocks have not been designed by PERMA-PIPE engineers, they may be sized by the following procedure:

EXAMPLE

Design an anchor block to resist the horizontal thrust of two 4 inch chilled water lines (supply and return) at a 90° elbow. The operating pressure is 150 psig, and the soil is soft clay.

TABLE I
POUNDS OF THRUST AT FITTINGS FOR 100 POUNDS PER SQUARE INCH OPERATING PRESSURE

Pipe Size	90° Bend	45° Bend	22½° Bend	Tee
1½"	415	225	115	295
2"	645	350	180	455
2½"	935	510	260	660
3"	1395	755	385	985
4"	2295	1245	635	1620
5"	3520	1910	975	2500
6"	4940	2680	1350	3500
8"	8550	4640	2340	6050
10"	15600	8500	4300	11000
12"	21250	11500	5850	15000
14"	26800	14500	7400	18900

Step 1. Find Thrust

From Table I, the resultant thrust of a 4 inch x 90° elbow is 2,295 pounds at 100 psi. At 150 psi, the thrust is:

$$2{,}295 \text{ lbs} \times \frac{150 \text{ psi}}{100 \text{ psi}} = 3{,}440 \text{ lbs/elbow}$$

3,440 lbs x 2 = 6,880 lbs thrust for 2 elbows

Step 2. Find the Bearing Area

From Table II, soft clay has a bearing strength of 1,000lbs/sq ft.

TABLE II

Safe Bearing Loads

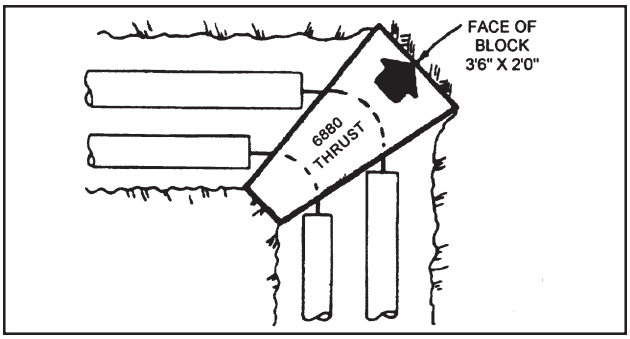
The safe bearing loads given in the following table are for horizontal forces when the depth of cover the conduit exceeds 2 feet.

Soil	Lb per Sq Ft
Muck, peat, etc.	0
Soft Clay	1,000
Sand	2,000
Sand and gravel	3,000
Sand and gravel cemented with clay	4,000
Hard shale	10,000

Therefore,

6,880 lbs thrust = 6.88 sq ft bearing area
1,000 lbs/sq ft

or a block 3 feet 6 inches x 2 feet (7 square feet) is adequate.

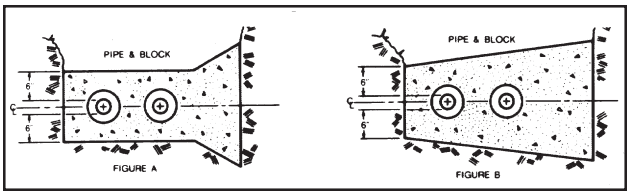


NOTE: In muck or peat, all thrusts are resisted by piles or tie rods to solid foundations or by removal of muck or peat and replacement with ballast of sufficient stability to resist thrusts.

Anchor blocks are made of concrete. Unless otherwise specified, an acceptable concrete is 1 part portland cement, 2 parts washed sand and 3 parts washed gravel with enough water for a relatively dry mix. The dry mix is easier to shape and offers higher strength.

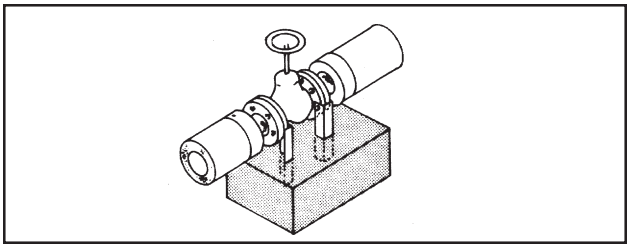
NOTE: It is important that the concrete be "worked" thoroughly around the elbows for maximum surface contact.

- Fill the entire area between the fittings and the fresh cut trench with concrete. This area must be free of voids.
- Shape the blocks with the designed bearing area against the trench wall. Smaller blocks using a fairly dry mix can be shaped by hand. Larger blocks will require simple forms.
- Undercut the trench beneath the pipes at least 6 inches to give added thrust resistance and to provide for an adequate concrete envelope around the fittings. At least 6 inches of concrete should be over the top of the pipe.
- In any case, the center of the anchor block's bearing surface should coincide with the horizontal center line of the pipes as shown in Figures A and B.

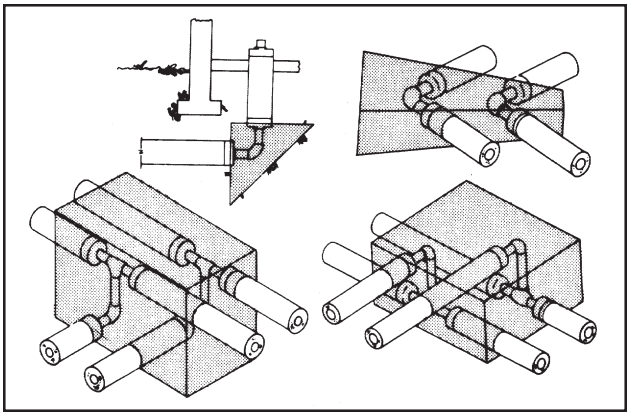


NOTE: Should the soil be unstable in the area requiring an anchor block, it will be necessary to consult an engineer. Unstable soil is a civil engineering problem, and expert advice is necessary.

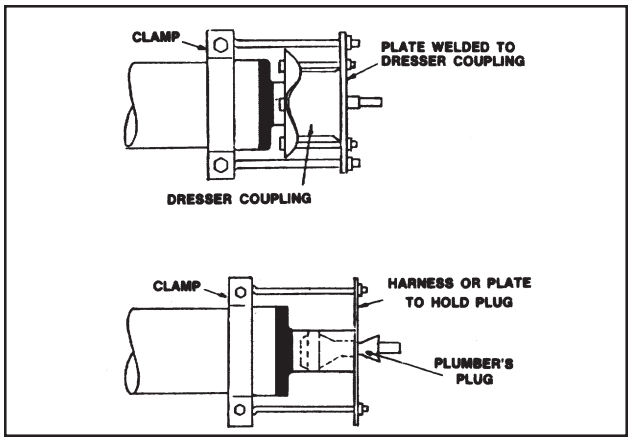
Blocks should be poured under valves with the necessary steel that can be connected to the valve. This supports the weight of the valve and prevents any torque or twisting action caused by opening and closing the valve.



Typical examples of anchor blocks for normal fittings are shown.



NOTE: For vertical risers, the trench bottom must be undercut and the entire elbow should be covered with concrete. The thrust blocks must bear against firm stable soil.



6.05 Hydrostatic Test of Carrier Pipe.

- Test line at recommended test pressure.

NOTE: DO NOT test the system at a pressure greater than 225 psi.

7.0 FIELD JOINT CLOSURE

After completion of the hydrostatic test, field joint closure is complete.

8.0 ALTERATIONS AND REPAIRS

8.01 Alterations.

All installations of CHIL-GARD require alterations of the piping in order to achieve the proper lengths. See Section **6.03.6** for details on cutting the pipe to length.

8.02 PVC Jacket Repair.

If cracked, a tight seal can be accomplished by patching with PVC cement and fiberglass tape:

- Prime the damaged area.
- Apply PVC cement.
- Apply tape.
- Apply PVC cement.

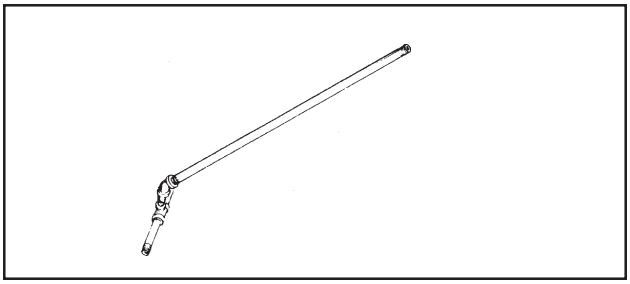
If damage is a large gouge or hole, use PVC sheet or a piece of regular PVC jacket formed to fit and cement on:

- Prime the damaged area.
- Apply PVC cement.
- Apply PVC patch.

9.0 BACKFILL PROCEDURES

9.01 Materials.

The most crucial part of the backfill process is the compaction of soil underneath and alongside the conduit. A hand tamping device can be constructed easily and economically by joining small diameter pipe. This tool will compact the soil firmly and evenly around the jacket and should be used instead of mechanical tampers when compacting to prevent damage to the Chil-Gard.



Special analysis of minimum burial depths is required at taxiways, runways, railways and other areas of high surface loading conditions. It is recommended that the customer contact both PERMA-PIPE and the local authority for more specific instructions.

9.02 Backfill Description.

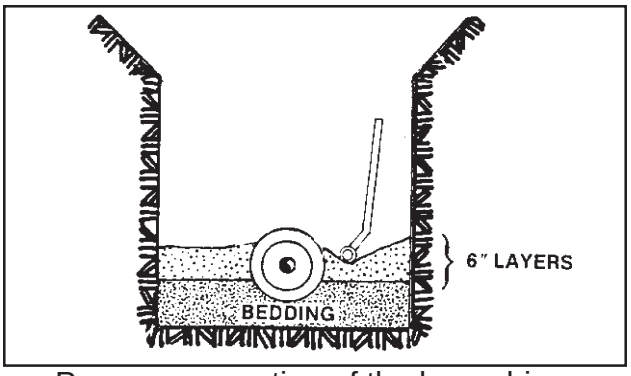
1. Sand or a sand-gravel mixture in which the gravel is either pea gravel or crushed stone without sharp edges.
2. Particles not larger than a half-inch in diameter.
3. 90% of the soil passing a No. 4 sieve.
4. 90% of the remainder retained by a No. 200 sieve.
5. Separate all unsuitable soil from the backfill soil.

9.03 Initial Backfill.

• Prior to backfilling, remove any foreign materials, such as shoring, braces and support blocks.

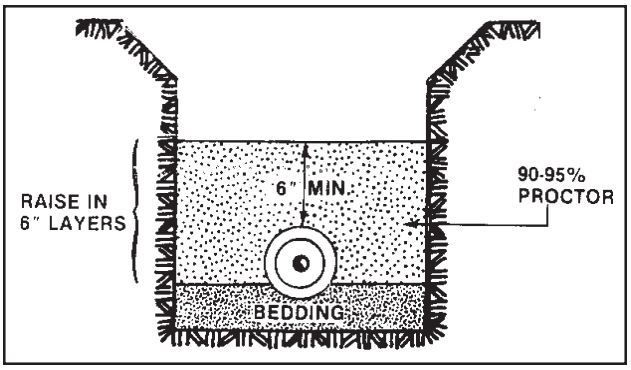
NOTE: DO NOT use frozen fill, sod, cinders or stones greater than a quarter inch in diameter as primary backfill.

• Carefully compact the area directly around the conduit in 6-inch layers.



• Proper compaction of the haunching materials, that section of the embedment extending from the bottom of the pipe to the springline, should be performed to provide soil densities as specified by the design engineer.

• Primary backfilling of selected earth should be packed and tamped to 6 inches minimum over the top of the jacket.



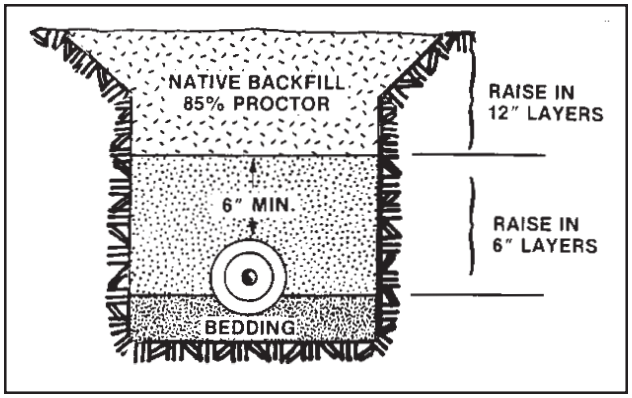
• Compact in 6 inch layers to 90-95% proctor. If surface loading conditions exist, backfill to grade in this manner.

NOTE: DO NOT use wheeled or tracked vehicles for tamping.

9.04 Final Backfill (85%) Compaction.

The backfill operation can now be completed by any convenient means. Remainder of backfill should be free of large boulders, and rocks larger than 6 inches in diameter, frozen earth, or foreign matter.

After placement and compaction of pipe embedment materials, the balance of backfill materials may be machine placed. Provide compaction to required soil densities. Use of mechanical compaction equipment to complete the final backfill is suggested, but **DO NOT use mechanical compactors until the conduit is covered with at least 12 inches of firmly compacted soil.**



Under normal conditions, backfill to grade in 1-foot lifts and compact to 85% proctor. Native soil can be used, provided it is non-organic and all particles are less than 1 inch in size.