PERMA-PIPE®

# Dual-Gard 250
# Preinsulated FRP Piping Systems

# Installation Manual

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## 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 Dual-Gard 250 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 Dual-Gard 250 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

Dual-Gard 250 is a completely preinsulated, prefabricated system designed for the distribution of chilled and low temperature hot water and condensate up to 250°F.

**NOTE:** It is important that flash tanks or other piping arrangements and accessories be used at high pressure drip points to prevent Dual-Gard 250 condensate lines being subjected to steam. Condensate pumped directly from vented condensate receivers requires no special accessories.

Dual-Gard 250 consists of a fiberglass reinforced plastic carrier pipe (150 psi maximum pressure), insulated with polyurethane foam, and encased and sealed in a rugged PVC jacket. The features that make Dual-Gard 250 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, Dual-Gard 250 will provide excellent service, meeting or exceeding expectations.

## 2.0 SCOPE AND APPLICATION

The scope of this procedure is limited to Dual-Gard 250 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 Dual-Gard 250, 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. Sanding tool, circular saw and blades
3. Shaving tool and heat blankets (available from PERMA-PIPE on rental basis)
4. 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 the following items from the carrier:
  1. Part Drawing Layout (PDL), if applicable
  2. Packing slip
  4. Bill of Lading
  5. 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.

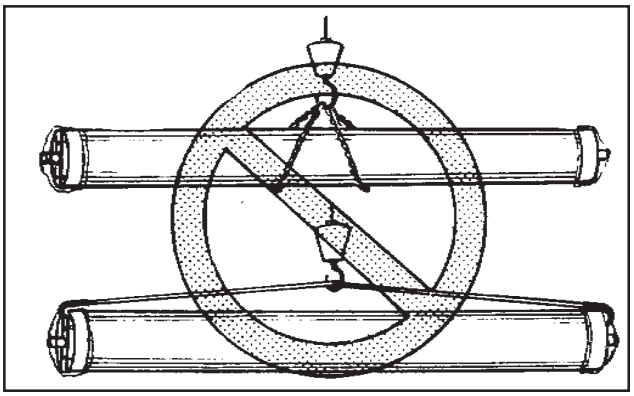
- Check all shipped materials against the packing slip for shortages.
- Visually inspect the materials of shipment as they are unloaded.
- List all damages and/or shortages on the packing slip and the bill of lading. **DO NOT dispose of any damaged material.** The carrier will notify you of the necessary 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 Dual-Gard 250 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:

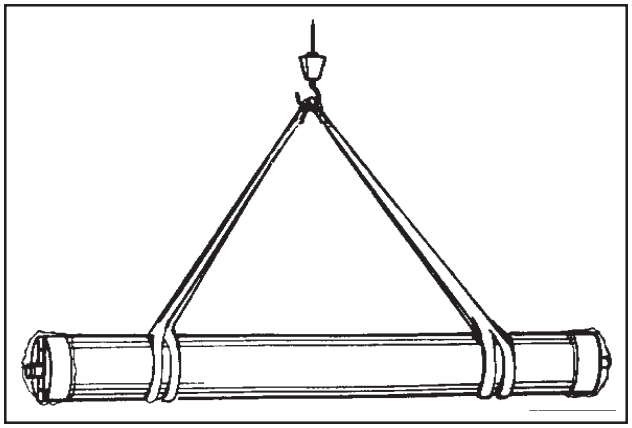
- Support each assembly with pipe size of 8 inches or larger with nylon slings during all phases of handling. The nylon slings prevent severe scratching and/or chipping of the PVC jacket. Nylon slings are provided free of charge by PERMA-PIPE.

• **DO NOT use steel cables or chains for handling Dual-Gard 250 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 Dual-Gard 250 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**).

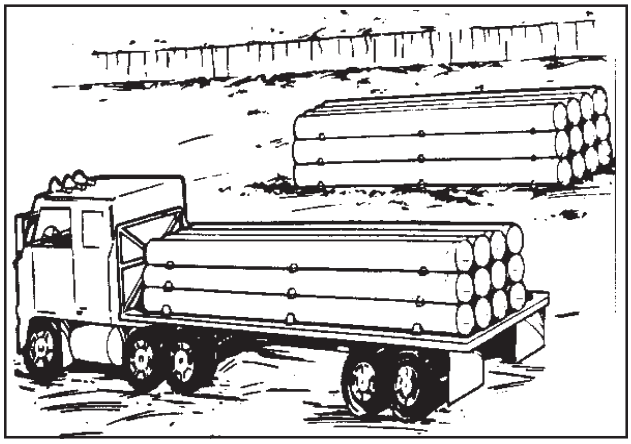
**3.02.3 Pipe Storage.**

Dual-Gard 250 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:

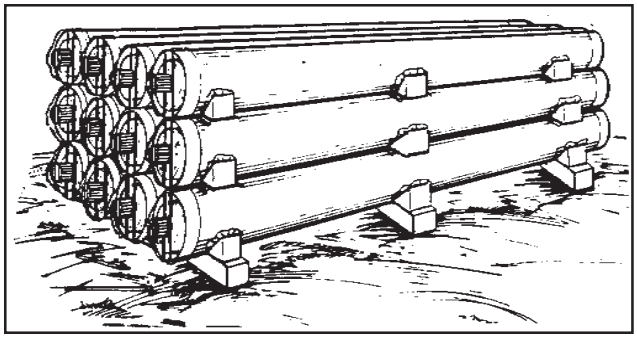
• If possible, store the pipe in a warehouse or heated shelter. If this is not possible, store the pipe on high ground to avoid ingress of water into pipe ends.

• Dual-Gard 250 can be stored during the winter months (or for prolonged periods of time) with minimal special handling.

• When stacking the Dual-Gard 250 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 Dual-Gard 250.** 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.

Dual-Gard 250 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.

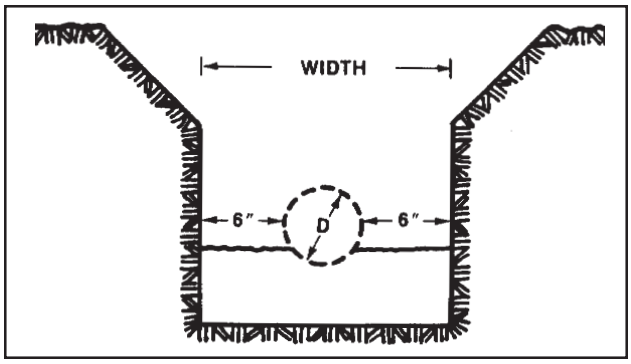
The trench floor should be completely cleared of stones and rocks and covered with a 4-inch compacted bedding. The bedding soil should correspond with the soil description.

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.

Local, state and federal regulations for shoring should be followed where applicable. As the shoring is removed, it should be replaced with backfill soil.

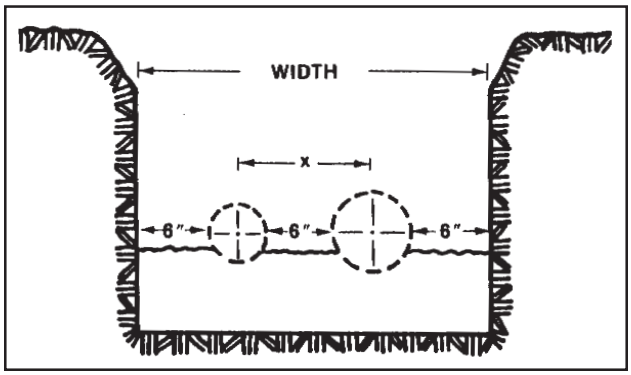
Organic soils or plastic clays and silts with high liquid limits may be encountered that are incapable of supporting the pipe. Remove the poor soil, and replace it with the proper bedding soil to a depth that will provide a firm stable foundation.

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

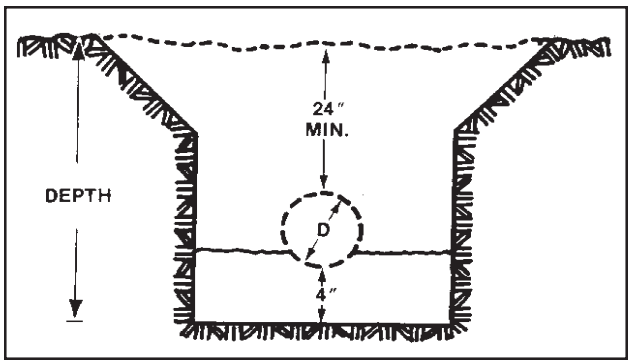



For multi-pipe installations, centerline dimensions can usually be found in the drawings.

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.



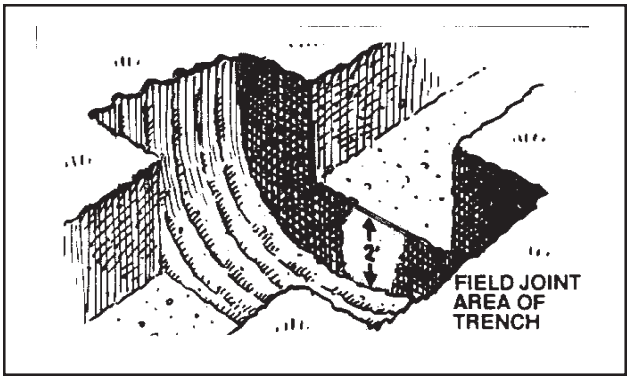

The total trench depth should allow for a 4-inch bedding, the conduit diameter and a minimum 24 inches cover depth above the conduit. See contract drawings for specific pipe burial depths. For depths less than 24 inches, contact PERMA-PIPE.



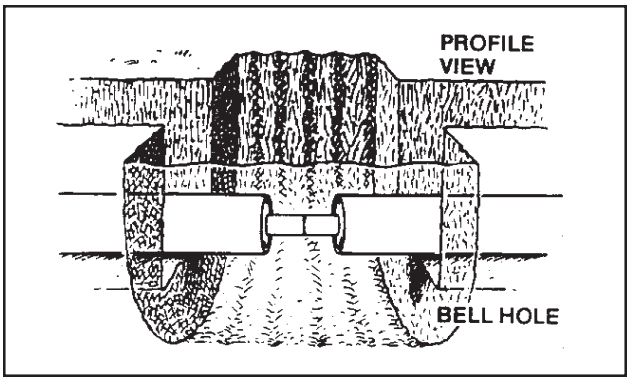
A minimum bedding of 4 inches must be raked uniformly along the entire length of the run. The bed of the run must be graded to a minimum slope of 1 inch per 40 feet. The bedding material should conform with the recommendations in the **Backfill** section of this manual (see Section **9.0**).

**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.

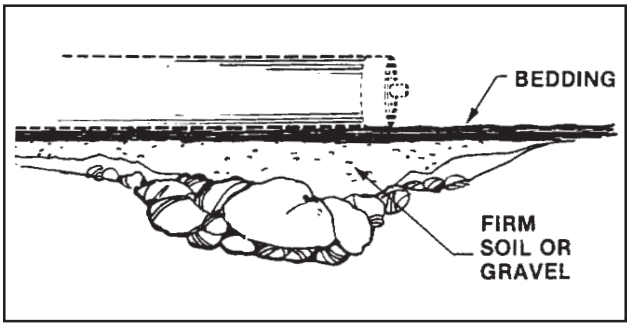



• Dig the bell holes before lowering Dual-Gard 250 into the trench.

**5.03 Special Trench Conditions.**

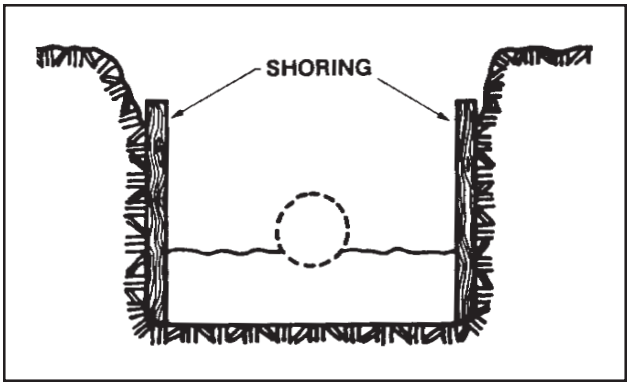
**5.03.1 Rock Bottom Trench.**

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




**5.03.2 Unstable Soil.**

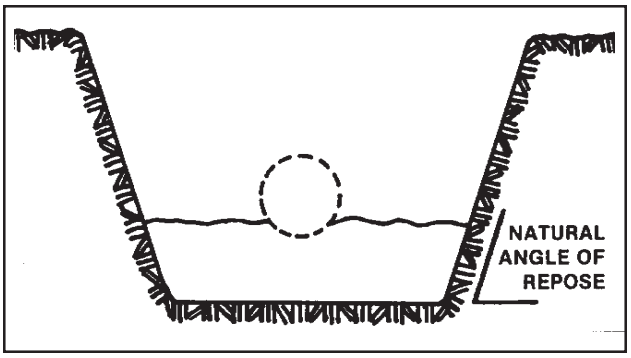
• When trenching in unstable soil, **DO NOT lay any Dual-Gard 250 until the trench walls are stabilized with staybracing or shoring.**




• 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 DUAL-GARD 250 ASSEMBLY

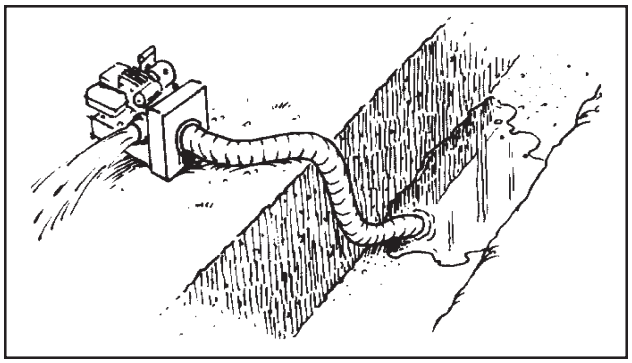
**NOTE:** When installing pipe in ambient temperatures below 60°F, contact your PERMA-PIPE field representative for special cold weather procedures.

**6.01 Layout.**

After trench excavation is complete and installation of the pipe is to start, the Dual-Gard 250 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 Dual-Gard 250 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 Preparation of Pipe Ends.**

All fitting sockets, pipe ends (spigots), and pipesockets must be clean and dry and must be sanded within two hours of assembly.

• Using a 1/4 inch drill motor (1700-2000 rpm) and a flapper type sander with a 40-50 grit aluminum oxide abrasive, sand the surfaces to be bonded. After sanding, the surfaces should show a dull fresh finish, not a polished look. End surfaces of the spigot must be sanded, as well.

**NOTE:** Clean and dry sanded surfaces are necessary for proper bonding.

• Thoroughly wipe the sanded socket and spigot with a clean, dry cloth to remove dust particles. If surfaces are wet, warm with heating blanket until dry, then resand. Protect the bonding surfaces from moisture during bad weather with tenting over the working area. **DO NOT touch the prepared surfaces with bare hands or other articles that would leave an oily film.**

• When necessary to cut a pipe to length, measure the desired length and scribe the pipe using a pipefitter's wrap-around. Cut pipe with hacksaw, sabresaw or abrasive wheel. Check the squareness of the cut by inserting a pipe shaver arbor flush into the cut pipe. Pipe up to 4 inches should be square with 1/16 inch. Larger pipe should be square within 1/8 inch. Use a disk grinder or file to correct squareness as required.

**NOTE:** All shaved ends should be sanded within two hours of assembly.

• Shave the cut end of the pipe using the pipe shaver. Measure the shaved pipe using a Pi Tape to ensure dimensions below are obtained:

| Pipe size | 2" | 3" | 4" | 6" | 8" | 10" | 12" |
|---|---|---|---|---|---|---|---|
| Dia--Max. | 2.346 | 3.466 | 4.446 | 6.560 | 8.560 | 10.696 | 12.700 |
| Dia--Min. | 2.330 | 3.450 | 4.430 | 6.544 | 8.544 | 10.680 | 12.684 |

SHAVED DIMENSIONS (inches)

• Use a clean, dry cloth to remove all glass dust from surfaces to be bonded, including 1/2 inch of the pipe interior.

• Mark the pipe 1 inch deeper than the socket insertion (varies with pipe size). This will permit a visual check to see if fitting is properly seated.

| Nom. Dia. | 2" | 3" | 4" | 6" | 8" | 10" | 12" |
|---|---|---|---|---|---|---|---|
| Mark in from Spigot End | $2\frac{13}{16}$" | $2\frac{13}{16}$" | $2\frac{13}{16}$" | 3¼" | 3½" | 3¾" | 4" |

When the spigot is bottomed in the socket, the scribed line will be 1 inch from the end of the socket.

**6.03.2 Application of Adhesive.**

The epoxy adhesive is a black, thermosetting material. This adhesive is formulated for use up to a maximum service termperature of 300°F.

- Store at temperature below 100°F.
- Each adhesive kit has an expiration date printed on it. **DO NOT use past this date.**
- **DO NOT use an adhesive kit if either container shows evidence of leakage.**
- **DO NOT make any one joint using adhesive from two kits.** For example, rather than using two 3 ounce kits to make a 10 inch or 12 inch joint, you must use one 6 ounce kit.
- Be aware of the working time available to you after the adhesive is mixed. The following table shows the approximate working time at various temperatures.

| Adhesive Temperature | Adhesive Pot Life (minutes) |
|---|---|
| 60°F | 45 min. |
| 80°F | 30 min. |
| 90°F | 25 min. |
| 100°F | 12 min. |

**NOTE:** If the adhesive is not within the 60°F-100°F range, you will need to warm or cool it before mixing. The adhesive won't mix and spread well below 60°F and will set up too fast above 100°F.

- Use soap and water to wash skin area which comes in contact with adhesive components. **DO NOT use solvents.** Use water-removable protective creams to avoid allergic reactions. Solvent-removable creams are not recommended. Disposable polyethylene gloves can be used to avoid contact between adhesive and hands.
- When the joint is ready to be bonded, add the contents of the small container (curing agent) to the large container (resin) and stir thoroughly, completely mixing the two components. Stir for at least one minute and until no streaks are visible in the mixture.
- Immediately after mixing, apply the adhesive to the surfaces to be bonded.

**NOTE:** If the mix has started to heat in the container, discard and start a new mix. Heating indicates the mix has started to cure.

- Use a scrubbing motion to apply a thin layer of adhesive approximately 1/32 inch thick to the surface of the socket and the pipe stop. Too much adhesive on the socket will result in a flow restriction inside the joint.
- Apply adhesive liberally to the entire spigot and a thin layer to the cut end of the pipe. Excess adhesive on the spigot surface will be pushed to the outside of the joint and can be easily removed.

**6.03.3 Joining Procedure.**

- Without delay, insert the pipe slowly into the socket until the spigot end rests firmly against the pipe stop. **DO NOT twist the pipe during insertion.**
- For 6 inch pipe and larger, use a light strap winch to seat and clamp the joint. Support the winch on a wooden bridge across the joint so the winch can be left snug while the heating blankert cures the adhesive.
- Smaller 2, 3, and 4 inch pipe is joined by tapping on a 2 x 4 wooden block placed over the pipe end to seat the spigot into the socket.

**NOTE: DO NOT use a metal hammer directly on FRP pipe or fittings.**

- Align flanges, tees and other fittings as you assemble the spigot and socket. Avoid rotating the part while assembling. Then, for flanges, check rotational alignment of bolt holes and squareness of flange faces. Flanges more than 1/16 inch out of square across the face, or fittings more than 1/2 degree out of alignment with the axis of the pipe, are likely to introduce subsequent assembly problems.

• Check for proper seating. The scribe mark on the spigot should now be one inch from the end of the socket.

• Clean up and remove excess adhesive from outside of joint and from front, back and inside of flange. Flange face must be clean and free of adhesive.

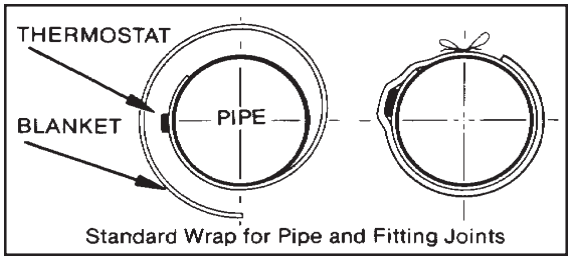
• Continue to couple units together, but take care that previously joined pipe is not moved. Preliminary backfill will help and also prevent flotation.

**6.03.4 Curing.**

• Place the thermostat end of the heating blanket against the assembled joint with the thermostat side facing out from the joint. Wrap the remainder of the blanket around the joint so any overlap will cover the thermostat. Tie the blanket in place with any nonconducting tie.

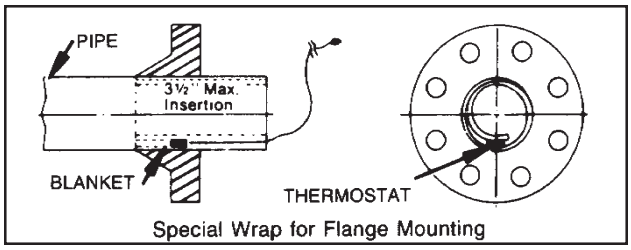
• Apply electric power to the heating blanket, marking the starting time on the pipe. Make sure the blanket is operating and, in fact, heats up.

• Insulate the heating blanket. Fiberglass insulation backed with aluminum foil generally works fine. Insulation should overlap the blanket sides about four inches each way and be tied down near the edges to trap heat.



Standard Wrap for Pipe and Fitting Joints

• Flange mounting requires a special wrap. Lay the blanket flat with the thermostat down and, starting at the thermostat end, roll up the blanket. Insert the rolled blanket into the pipe end, a maximum of 3 ½ inches, leaving the cord and part of the blanket exposed as shown. Fill the space inside the rolled blanket to ensure that the blanket remains snugly against the inside joint surface.



Special Wrap for Flange Mounting

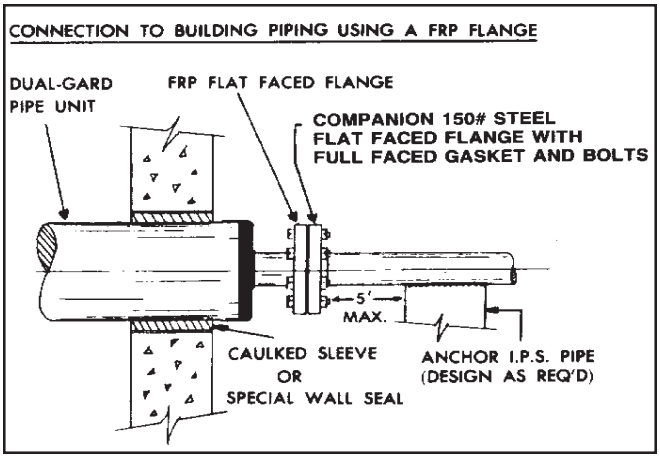
**NOTE: DO NOT move, vibrate or otherwise disturb the joint during cure of adhesive.**

Pipe joints and flange mountings require 30 minutes to cure; fitting joints require 45 minutes to cure.

If the temperature of the system can change more than 200°F, contact a PERMA-PIPE representative for more explicit instructions.

**6.03.5 FRP Flanges.**

FRP 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 FRP pipe.




• Use full-faced ethylene propylene 1/8 inch gaskets of 60 +/- 5 shore A durometer hardness such as Garlock #8314, West American #60K20, Goodrich #EPDM-60, or Goodyear Versigard.

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

• For small diameter pipe (through 6 inches), maximum bolt torque is 25 foot pounds. Consult a PERMA-PIPE representative for information on larger sizes.



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• 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.

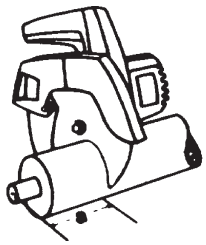
• Use care when installing elbows and tees. Provide sufficient anchor when making connections at direction changes (see Section **6.05**).

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

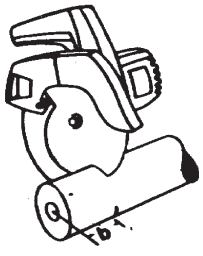
**NOTE: DO NOT bend or bow assembled units in trenches.** Handling of assembled units is discouraged. In-place assembly is recommended.

**6.03.6 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 bitumastic over the insulation. Apply second coat one hour after applying the first coat. **DO NOT thin bitumastic.**

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

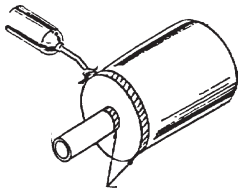
If shrink end caps are required, proceed as follows:

• Remove urethane residue with sandpaper or emery cloth. Wipe clean and dry with clean cloth to remove dust.

• Clean end of jacket (3 inch minimum) with MEK.

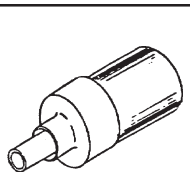
• Gently warm jacket end and pipe surface with propane torch using soft orange flame. **DO NOT burn jacket or pipe.**

• Apply adhesive sealant strip around jacket end and around pipe, tight against insulation. Make certain adhesive sealant covers the total circumference. Heat strip gently until it starts to soften.

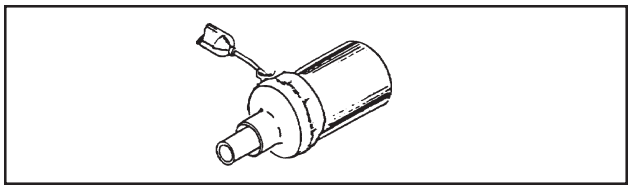


ADHESIVE SEALANT

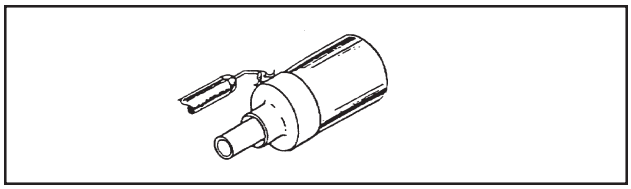
• Place the heat shrinkable rubber end cap over the end of the pipe and push it as far as it will go onto the insulation.



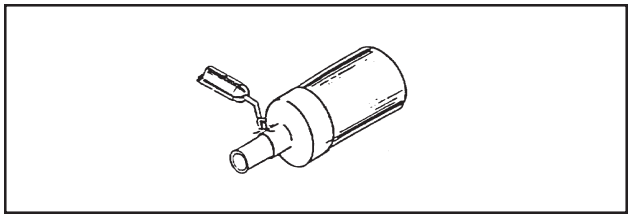
• Heat the front of the large end of the cap with a small propane or butane torch with the flame angled out torward the casing until it is tight around the pipe casing all around.



• Heat the remainder of the large end until it is uniformly recovered. Ensure that sufficient heat has been applied to bond the adhesive.



• Shrink the small end by angling the torch toward the intersection point of the pipe and insulation, then complete by shrinking toward the end of the cap.



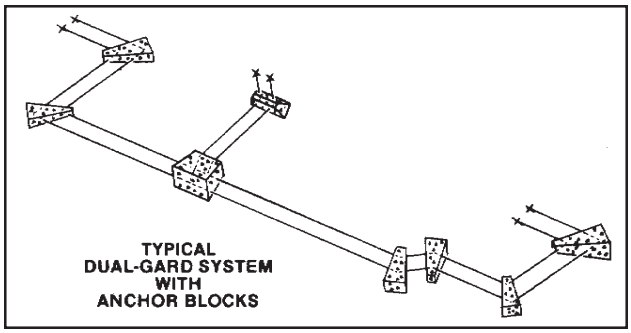
**6.04 Concrete Anchor Blocks.**

Anchor blocks must be included to prevent any pipe movement as a result of changes in temperature. Fiberglass reinforced plastic pipe has the ability to absorb this expansion or contraction, but the pipe must be restrained with anchor blocks for proper control. The anchor block must encapsulate the fitting to be effective in both tension and compression. Poured concrete is the preferred method of anchoring the Dual-Gard 250 assemblies.

**NOTE:** Pour anchor blocks after hydrostatic testing of the pipe. This will allow clear visual inspection of all fitting joints during the test.

Anchor blocks must be located at:

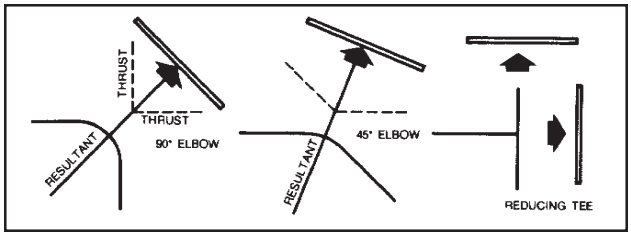
1. All changes in direction, such as tees and elbows (both horizontal and vertical).
2. All changes in size such as reducers.
3. All terminal or “dead” ends, such as caps, plugs and closed valves.
4. All valves, in order to support their weight and prevent excessive torque on the pipe connections.




**NOTE:** Any connecting metallic pipe must be anchored at the point of connection to the FRP pipe to prevent excessive stresses being transferred to the FRP 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 hot water lines (supply and return) at a 90° elbow. The operating temperature is 230°F, and the

**TABLE I**

Forces Due to Thermal Stress in Pounds

| Size | At Ends or Tees | 90° Elbow | 45° Elbow |
|---|---|---|---|
| 2” | 2,300 | 3,250 | 1,760 |
| 3” | 3,300 | 4,670 | 2,520 |
| 4” | 5,600 | 7,900 | 4,270 |
| 6” | 8,300 | 11,700 | 6,350 |
| 8” | 12,000 | 17,000 | 9,200 |
| 10” | 15,000 | 21,200 | 11,500 |
| 12” | 17,900 | 25,400 | 13,700 |

Computed for total range through 250°F soil is sand.

Step 1. Find Thrust

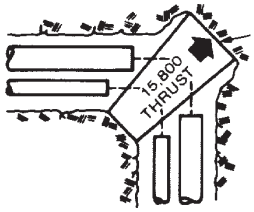
From Table I, the resultant thrust of a 4 inch x 90° elbow is 7,900 pounds (forces are assumed the same through the temperature ranges to 250°F).

7,900 lbs x 2 = 15,800 lbs thrust for 2 elbows

Step 2. Find the Bearing Area

From Table II, sand has a bearing strength of 2,000lbs/sq ft. Therefore,

15,800 lbs thrust = 7.9 sq ft bearing area
2,000 lbs/sq ft




FACE OF BLOCK
2 FEET X 4 FEET

or a block 2 feet x 4 feet is adequate.

**TABLE II**

Safe Bearing Loads

The safe bearing loads given in the following table are for horizontal forces when the

| 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 |

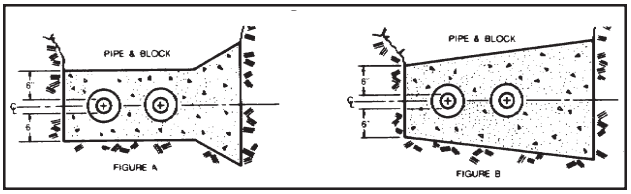
depth of cover the conduit exceeds 2 feet.

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.

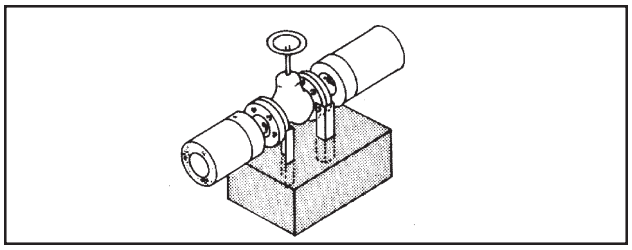
- Fill the entire area between the fittings and the fresh cut trench with concrete. This area must be free of voids.
- Shape the blocks with the designed bearing area against the trench wall. Smaller blocks using a fairly dry mix can be shaped by hand. Larger blocks will require simple forms.
- Undercut 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



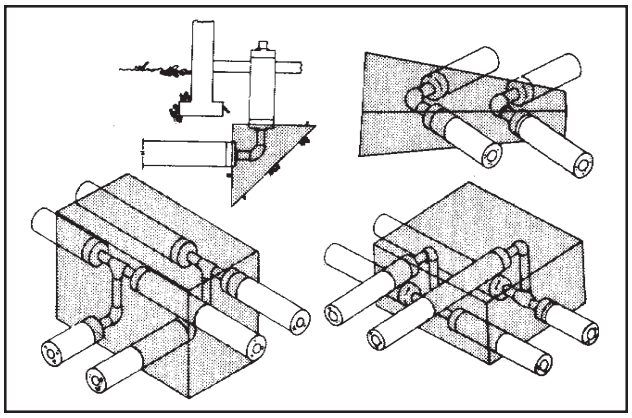

the horizontal center line of the pipes as shown in Figures A and B.

**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.



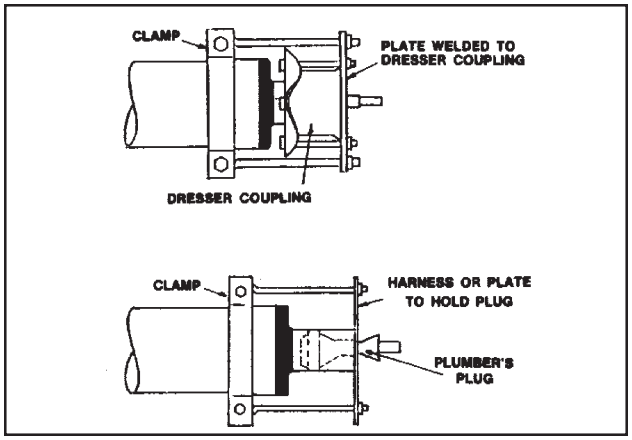
Typical examples of anchor blocks for normal fittings are shown.



**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 Dual-Gard 250 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.

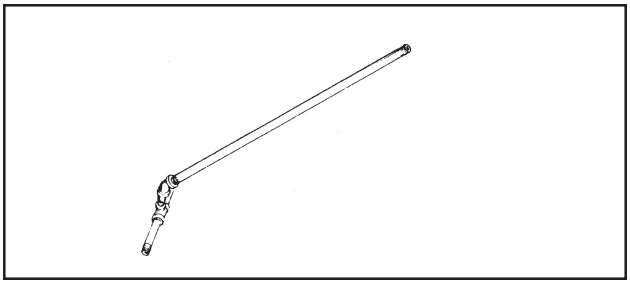
If damage is a large gouge or hole, use PVC sheet or a piece of regular PVC jacket formed to fit and cement on:

- 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 Dual-Gard 250.



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.**

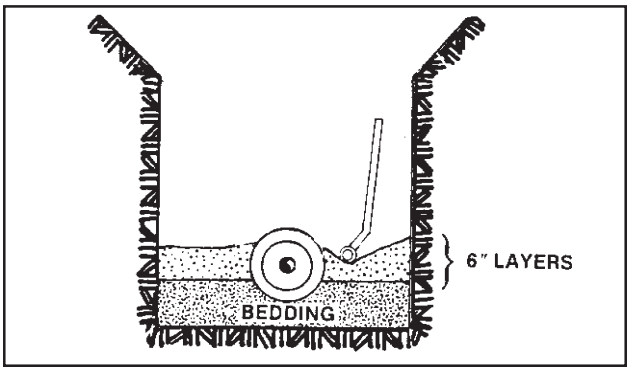
1. Sand or a sand-gravel mixture in which the gravel is either pea gravel or crushed stone without sharp edges.
2. Particles not larger than a half-inch in diameter.
3. 90% of the soil passing a No. 4 sieve.
4. 90% of the remainder retained by a No. 200 sieve.
5. Separate all unsuitable soil from the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

**9.03 Initial Backfill.**

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

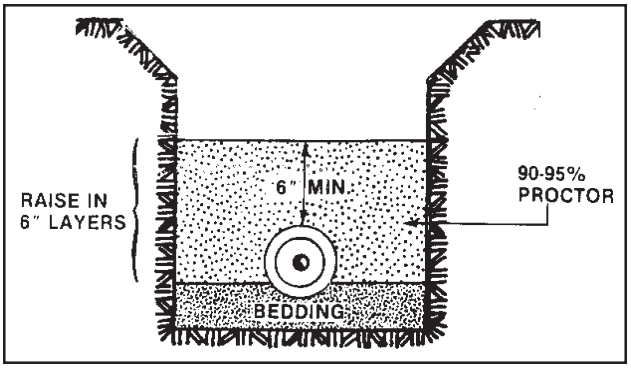
**NOTE: DO NOT use frozen fill, sod, cinders or stones greater than a quarter inch in diameter as primary backfill.**

• 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.



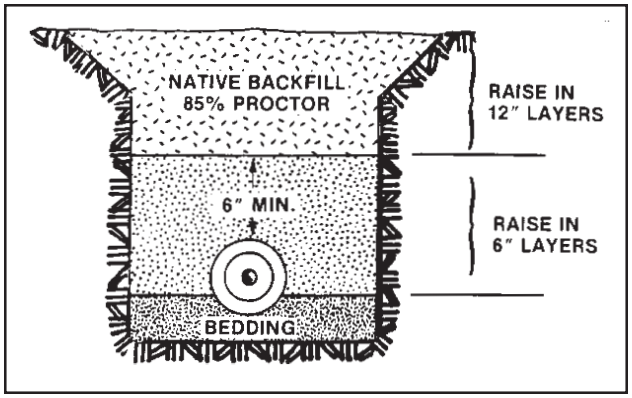

• Compact in 6 inch layers to 90-95% proctor. If surface loading conditions exist, backfill to grade in this manner.

**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.